



United States
Environmental Protection
Agency

Office Of Air Quality
Planning And Standards
Research Triangle Park, NC 27711

EPA-452/R-02-005
April 2002
Final Report for Proposal

Air

Economic Impact Analysis of Metal Can MACT Standards



***Economic Impact Analysis of Metal Can
MACT Standards***

***U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Innovative Strategies and Economics Group, C339-01
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April 2002

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SECTION 1 INTRODUCTION

The U.S. Environmental Protection Agency (referred to as EPA or the Agency) is developing an air pollution regulation designed to reduce emissions generated by the metal can manufacturing industry. In the baseline for this analysis, the U.S. metal can manufacturing industry was comprised of 202 establishments, which were owned by 30 domestic and foreign companies and employed more than 160,000 workers.¹ Of these facilities, 142 are classified as major sources of hazardous air pollutant (HAP) emissions,² primarily due to emissions occurring during the coating process. Under Section 112 of the 1990 Clean Air Act (CAA) Amendments, EPA is currently developing national emission standards for hazardous air pollutants (NESHAP) to limit these emissions. This report presents the results of an economic impact analysis (EIA) in which a market model was used to evaluate the economic impacts associated with the proposed regulation.

1.1 Agency Requirements for Conducting an EIA

Congress and the Executive Office have imposed statutory and administrative requirements for conducting economic analyses to accompany regulatory actions. Section 317 of the CAA specifically requires estimation of the cost and economic impacts for specific regulations and standards proposed under the authority of the Act. In addition, Executive Order (EO) 12866 and the Unfunded Mandates Reform Act (UMRA) require a more comprehensive analysis of benefits and costs for proposed significant regulatory actions.³ Other statutory and administrative requirements include examination of the composition and distribution of benefits and costs. For example, the Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement and Fairness Act of 1996 (SBREFA), requires EPA to consider the economic impacts of regulatory actions on small entities. The Agency's *Economic Analysis Resource Document* provides detailed instructions and expectations for economic analyses that support rulemaking (EPA, 1999).

1.2 Scope and Purpose

The CAA's purpose is to protect and enhance the quality of the nation's air resources (Section 101(b)). Section 112 of the CAA Amendments of 1990 establishes the authority to determine a NESHAP. This report evaluates the economic impacts of pollution control requirements placed on metal can manufacturing establishments under these amendments. These control requirements are designed to reduce releases of HAPs into the atmosphere.

To reduce emissions of HAPs, the Agency establishes maximum achievable control technology (MACT) standards. The term "MACT floor" refers to the minimum control technology on which MACT standards can be based. For existing major sources, the MACT floor is the average emissions

¹These establishments include those that produce steel or aluminum cans, metal sheets used for can production, and/or can ends. Metal cans are primarily used in packaging foods and beverages. They are also used in general packaging applications for products such as paint and aerosol cans.

²A major source of HAP emissions is defined as a facility that emits, or has the potential to emit, 10 or more tons of any HAP or 25 or more tons of any combination of HAPs.

³Office of Management and Budget (OMB) guidance under EO 12866 stipulates that a full benefit-cost analysis is required when the regulatory action has an annual effect on the economy of \$100 million or more.

limitation achieved by the best performing 12 percent of sources (if there are 30 or more sources in the category or subcategory). For new sources, the MACT floor must be no less stringent than the emissions control achieved in practice by the best controlled similar source. The MACT can also be chosen to be more stringent than the floor, considering the costs and the health and environmental impacts. This report analyzes the economic effects of the metal can manufacturing MACT floor on existing sources.

1.3 Organization of the Report

The remainder of this report is divided into four sections that describe the metal can manufacturing industry, present the methodology used for the analysis, and summarize the results of this EIA:

- C Section 2 provides a summary profile of the metal can manufacturing industry. It describes the affected production process, inputs, outputs, and costs of production. It also describes the market structure and the uses and consumers of metal cans.
- C Section 3 reviews the regulatory control alternatives and the associated costs of compliance. This section is based on EPA's engineering analysis conducted in support of the proposed NESHAP.
- C Section 4 outlines the methodology for assessing the economic impacts of the proposed NESHAP and the results of this analysis, including market, industry, and social welfare impacts. In addition, this section describes the economic impacts specific to new sources in the metal can manufacturing industry and economic impacts on the energy sector.
- C Section 5 addresses the proposed regulation's impact on small businesses.

In addition to these sections, Appendix A further details the economic model used to predict the economic impacts of the NESHAP and Appendix B presents the results of sensitivity analyses performed for the demand and supply elasticities used in the economic model.

SECTION 2

INDUSTRY PROFILE: METAL CAN MANUFACTURING

Cans are one of the most widely used containers in the world. Industry estimates that more than 200 million cans are used each day in the United States (Can Manufacturers Institute [CMI], 1999a). Consumers use metal cans for a variety of purposes, including the storage of food, beverages, and many other products (e.g., paint). During the production process, a variety of surface coatings are applied to these cans. Interior coatings prevent corrosion and protect the contents from being contaminated by the can. Exterior coatings are applied for decoration, to protect printed designs, or to facilitate handling by reducing friction. Traditional coatings used in this industry have a high concentration of solvents, which results in the emission of volatile organic compounds (VOCs) and HAPs. Currently, the U.S. Environmental Protection Agency (EPA) is developing national emissions standards for these HAPs.

This section provides an economic overview of the metal can industry. Section 2.1 describes the production processes with emphasis on surface coatings. Section 2.2 identifies uses, consumers, and substitutes. Section 2.3 summarizes the organization of the U.S. metal can industry, including a description of the manufacturing facilities and the companies that own them. In addition, we identify small businesses potentially affected by the proposed rule. Finally, Section 2.4 presents market data for the industry, including U.S. production, prices, foreign trade data, and trends.

2.1 Production

The can manufacturing process has changed dramatically since its beginnings in the early 19th century. Today's automated processes have replaced the once labor-intensive process and produce an estimated 139 billion cans per year (CMI, 2001a). Metal can manufacturers purchase two primary raw material inputs for the production of cans: steel and aluminum. In 1999, almost three-quarters of all metal cans produced were aluminum (CMI, 2001a). These two raw material inputs are used to produce one-, two-, and three-piece can bodies and can ends. During the production process, the steel or aluminum (in the form of sheets or coil) is shaped, coated, quality checked, and prepared for shipment to a variety of consumers across the United States and the world. The following sections describe individual manufacturing processes in greater detail. Much of the information in these sections was taken from EPA (1998).

2.1.1 Sheet Manufacturing

The process of manufacturing metal sheets for use in metal can manufacturing begins by cutting a large coil of metal into pre-scrolled sheets. An inside protective coating is then placed on the sheets and cured. At this point the sheets can be decorated. An over coat of varnish is placed on the decorated sheet and cured again. A second inside protective coating is placed on the sheets and cured. These pre-scrolled sheets are then cut into small scroll sheets which can be fed into the end or body making process (CMI, 2001b).

2.1.2 Can End Manufacturing

The production of can ends varies by end use. Aluminum beverage can ends are made from precoated coil that is stamped and scored to produce an oval pattern, and an end tab is attached. This end is attached to the can with a solvent- or water-based compound, and the seal is allowed to dry. The production process of ends for food cans and other sheet-coated ends is similar to beverage cans with the exception that food can and other sheet-coated ends are typically coated on metal sheets rather than coils.

2.1.3 One- and Two-Piece Can Body Manufacturing

The one- and two-piece can manufacturing process involves forming a can body, creating an end (for the two-piece can), and applying coatings to the open can and can top. Two fabrication processes are used to produce these cans: the draw-redraw process and the draw-and-iron process. Manufacturers

of one-piece can bodies use the draw-and-iron process, while two-piece can manufacturers use both processes.

During the draw-redraw process, aluminum or steel coil is fed into a processor called a cupper that stamps shallow metal cups. The coil may be stamped one or two additional times to create a deeper can. This process typically uses pre-coated coils and if no additional coating steps are required, the cans are tested and stored. However, some manufacturers use an uncoated coil and perform sheet coating similar to the three-piece can body coating operation described in Section 2.1.4.

In contrast, the draw-and-iron process involves the following additional steps after the shallow cup is created. Full-length can bodies are created from shallow cups through an extrusion process (aluminum cans) or “ironing” process (steel cans). The can bodies are then trimmed, cleaned, and dried in preparation for the application and curing of exterior base coats, printing inks, and protective overvarnish coats (aluminum beverage cans) or corrosion-resistant wash coats (steel food cans). Once the coatings are dry, the can necks are flanged (beverage) or beaded (food cans). A leak tester applies air pressure to each can and tests for any holes or cracks and rejects any inadequate cans. In addition, the coating thickness may be tested by a random electrical resistance spot check. After passing these tests, the finished cans are then stacked for storage or shipment. Figure 2-1 provides a detailed example of a two-piece draw-and-iron aluminum beverage can production process.

2.1.4 Three-Piece Can Body Manufacturing

Three-piece cans are typically made of steel sheets. The manufacturing process involves two operations: sheet coating and can fabrication (see Figures 2-2 and 2-3). The sheet coating operation includes the application of a base coat, inks, and overvarnish. After application, the sheet passes through an oven for curing and drying. The can fabrication begins with the processor slitting these coated sheets and feeding them into a “body maker” where the seams are welded or cemented together. The seam along the side of the can is welded or cemented and then coated in a process called “side seam stripe application.” This seam may be coated with an interior spray or an exterior spray, or on both sides. The side seam stripe protects exposed metal along the seam. At this stage of the production process, the cans are flanged for proper can end assembly and the diameter of the wall may be reduced (necked-in) according to end-use requirements. In addition, if the can will be used to store beverages, the can’s interior is sprayed with a protective coating and then baked or cured. After curing, the end seamer attaches one end to the can in a process called “double seaming” where end seal compounds are applied and used as a gasket material to provide an airtight seal. Afterwards, the leak tester checks for leakage. The finished can is stacked and prepared for shipment.

2.1.5 Coatings and Emissions

Coating is an integral part of the production processes of cans and can parts. Without the specialized interior coatings, cans could potentially contaminate their contents and render them dangerous to consumers. Exterior coatings enhance the can’s appearance, protect the can from

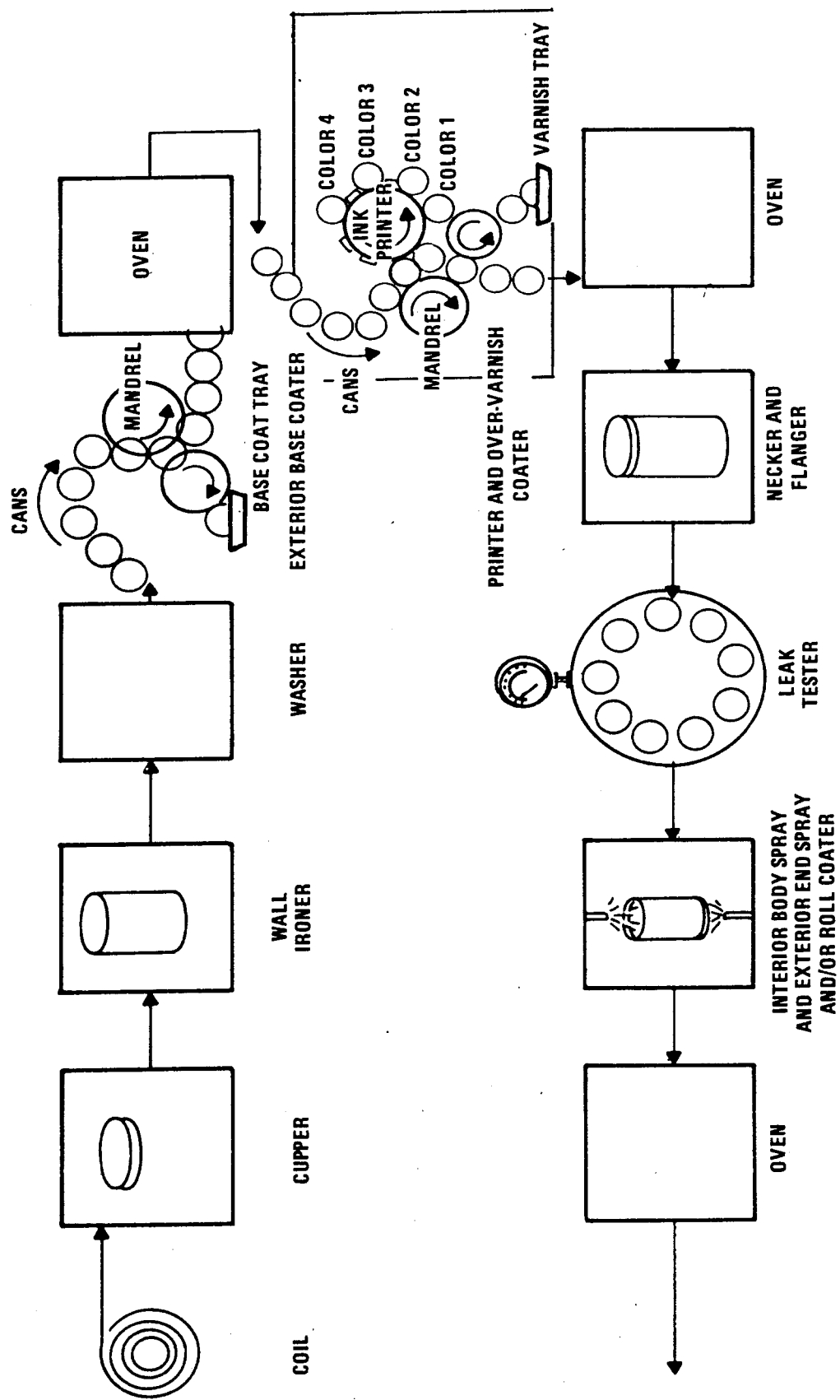


Figure 2-1. Two-Piece Draw-and-Iron Aluminum Beverage Can Manufacturing Process

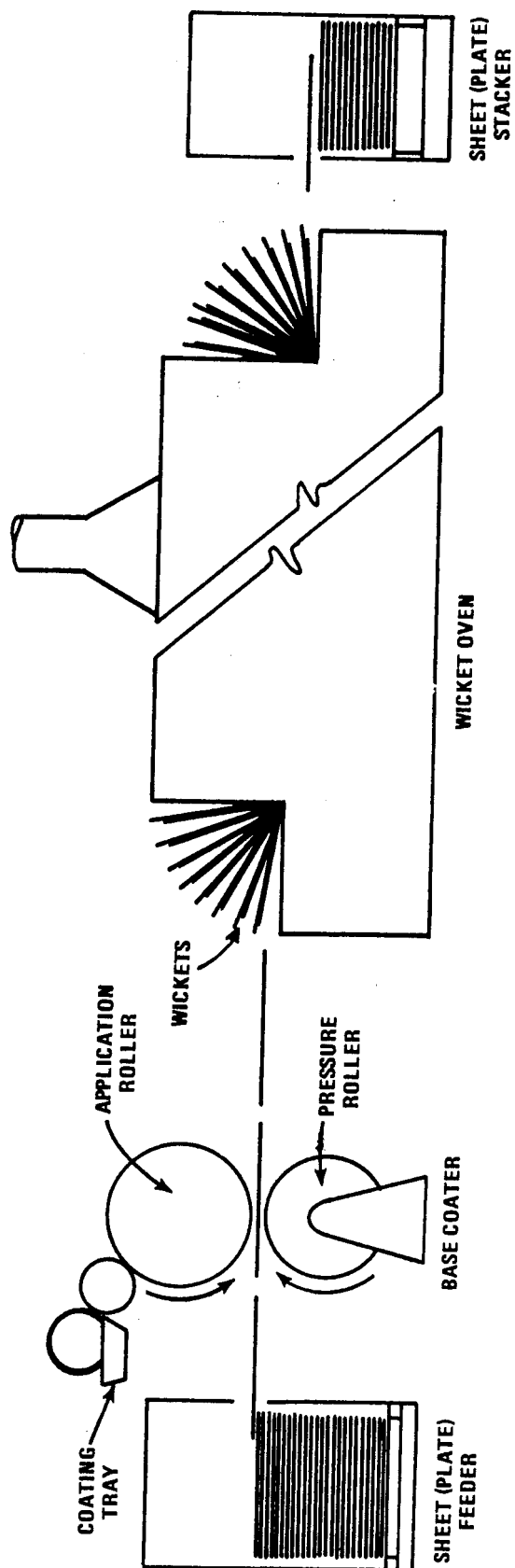


Figure 2-2. Three-Piece Can Sheet Base Coating Operation

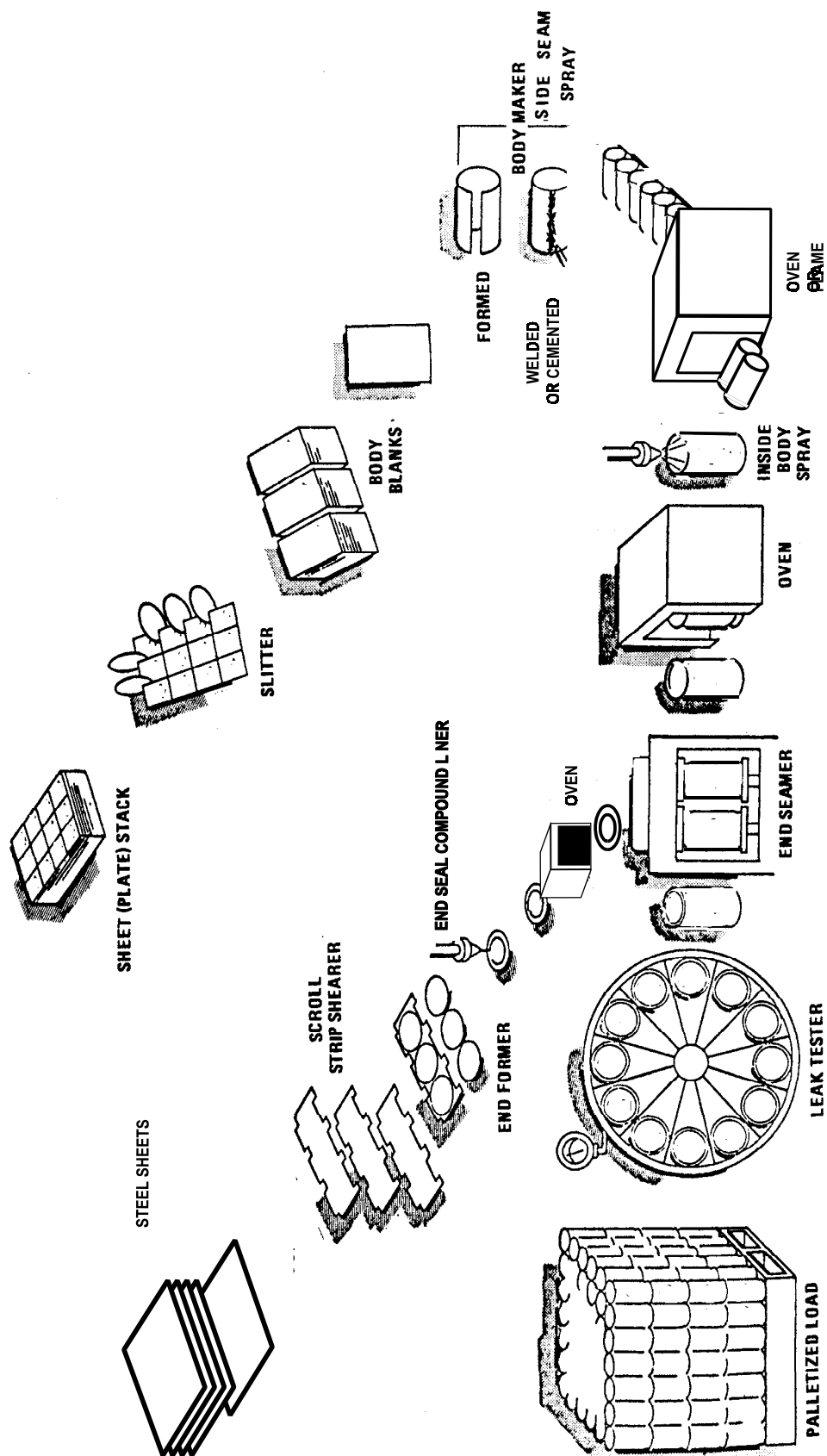


Figure 2-3. Three-Piece Can Fabrication Process

corrosion, and protect printed designs. However, the traditional coatings used in the metal can industry have a high concentration of solvents, which results in the emission of VOCs and HAPs. Several types of coating technologies exist:

- C Conventional solvent-borne coatings—Conventional coatings offer good abrasion resistance and ease of application. However, they have high concentrations of VOCs and HAPs.
- C High-solid coatings—The most widely used high-solid coating is polyurethane. These coatings are used as exterior bases, some interior sheet coatings, decorative inks, and end seal compounds.
- C Waterborne coatings—These coatings are used extensively in beverage can manufacturing.
- C Ultraviolet radiation-cured (UV-cured) coatings—UV-cured coatings offer advantages of rapid curing, low process temperatures, and low VOC and HAP content as well as lower energy costs because drying ovens are eliminated. However, UV coatings are expensive and require specialized equipment.
- C Powder coatings—These coatings offer excellent resistance to chemicals, abrasion resistance, and barrier qualities. The application process for these coatings is currently not fast enough for can coating line operating speeds, and only limited numbers of colors, finishes, and textures are available for can manufacturers (EPA, 1998).

Coatings are applied to both interior and exterior can bodies and ends. Emissions are generated during coating application, during transportation to the oven (evaporation), and during curing. However, approximately 50 to 80 percent of emissions occur during the drying and curing process (EPA, 1998).

2.1.6 Costs of Production

Raw material and energy costs account for the largest share of the variable costs of metal can production. In 1997, the cost of materials and energy totaled \$8.6 million, or 72 percent of the metal can industry's value of shipments. Steel and aluminum purchases totaled \$8.1 million, or 94 percent of the cost of materials.

Recently, prices for steel and aluminum sheet, plate, and coil have fluctuated given the changes in market conditions for these inputs. For 2001, Purchasing Online (2001) reported spot prices for a cold-rolled steel sheet at \$320 per ton, coiled-steel plate at \$288 per ton, and aluminum common alloy sheet at \$1,720 per ton (see Table 2-1). The data show the price of steel has dropped significantly since 1997 as foreign steel imports have surged. For September 1997, spot prices for cold-rolled steel sheet and coiled steel plate were quite a bit higher than more recent levels at \$480 and \$390 per ton, respectively. In 1995, a shortage of aluminum led to significant raw material price increases, forcing beverage canners, such as Coca-Cola and Pepsico, to increase the use of alternative packaging containers such as plastic bottles (Sfiligoj, 1995). However, aluminum prices decreased significantly in 2001.

Table 2-1. Spot Prices for Steel and Aluminum Sheet and Plate: 1997-2001

Year	1997	1998	1999	2000	2001
Cold-rolled steel sheet (Midwest, \$/ton)	\$480	\$410	\$390	\$380	\$320
Coiled steel plate (Midwest, \$/ton)	\$390	\$400	\$300	\$320	\$288
Aluminum (common alloy sheet 3003, \$/ton)	\$2,200	\$1,920	\$2,040	\$2,240	\$1,720

Source: Purchasing Online. September 15, 1998. "Transaction Prices." Purchasing Online.
Purchasing Online. September 16, 1999. "Transaction Prices." Purchasing Online
Purchasing Online. September 20, 2001. "Transaction Prices." Purchasing Online

Labor is used throughout the production process as well as during transportation of the product. However, labor costs account for only a small share of variable production costs in the metal cans industry. In 1997, payroll represented only 10 percent of the value of shipments.

In 1995, industry estimated that approximately 20 million gallons of coating materials were consumed annually by two-piece beer and beverage can manufacturers (Sfiligoj, 1995). A more recent estimate shows that two-piece beverage manufacturing facilities used 26 million gallons of coating in 1997 (Reeves, 1999). Using data on the volume and value of coatings shipped to the metal coil coating industry, the Agency estimates the average cost of coatings for 1997 at \$15.60 per gallon (Bourguignon, 1999). However, it is likely that some specialty coatings sell for substantially more—as high as \$50 per gallon.

The U.S. Bureau of the Census (Census Bureau) and U.S. Bureau of Labor Statistics (BLS) publish historical statistics for costs of materials (i.e., materials, fuels, electricity) and labor for the metal can industry using the following classification systems:

- C North American Industrial Classification System (NAICS)—beginning with the 1997 Economic Census, the metal cans industry was classified under NAICS code 332431, Metal Can Manufacturing.
- C 1987 Standard Industrial Classification (SIC) codes—prior to 1997, the metal cans industry was classified under SIC 3411, Metal Cans.

As shown in Table 2-2, the cost of materials averaged 72 percent of the industry's value of shipments between 1992 and 1997, while payroll represented roughly 10 percent of the value of shipments. Wages for production workers ranged from \$15.86 to \$17.34 per hour during this period.

2.2 Uses, Consumers, and Substitutes

Historically, steel cans were primarily used to store prepared raw food products. During the 1970s and 1980s, the use of metal cans expanded to the beverage market, and aluminum cans subsequently captured a significant share of the market (Hillstrom, 1994). Today, it is estimated that Americans use approximately 200 million cans each day. Metal cans are used for a wide variety of products, such as soft drinks, food products, and aerosol cans. Table 2-3 lists selected end uses for metal cans.

In 1997, the baseline year selected for this analysis based on data availability, more than 130 billion metal cans were shipped to three primary market segments—beverage, food, and general packaging (CMI, 1999b). Figure 2-4 shows the distribution of shipments of metal cans by market for

1997. As shown, the beverage market accounts for the largest share of metal cans (73.4 percent), followed by food (23.4 percent) and general packaging (3.2 percent).

CMI reports that nearly all beverage cans are made of aluminum. A recent survey conducted by the aluminum beverage can industry identified characteristics of aluminum cans that consumers found attractive compared to other packaging alternatives (CMI, 1999c). These include

Table 2-2. Historical Cost of Production Statistics for the Metal Cans Industry: 1992-1997

Year	Value of Shipments (\$10 ⁶)	Cost of Materials (\$10 ⁶)	Cost of Materials Share (%)	Payroll (\$10 ⁶)	Payroll Share (%)	Average Earnings of Production Workers (\$/hr)
1992	\$12,112	\$8,798	72.6%	\$1,262	10.4%	\$15.86
1993	\$11,498	\$8,360	72.7%	\$1,212	10.5%	\$16.23
1994	\$11,610	\$8,306	71.5%	\$1,256	10.8%	\$16.50
1995	\$12,326	\$9,084	73.7%	\$1,183	11.2%	\$16.74
1996	\$12,273	\$8,624	70.3%	\$1,194	9.6%	\$16.98
1997	\$12,007	\$8,598	71.6%	\$1,183	9.8%	\$17.34
Total/Average	\$71,825	\$51,770	72.1%	\$7,485	10.1%	\$16.61

Sources: U.S. Department of Commerce, Bureau of the Census. 1999a. *1997 Census of Manufacturing Industry Series: Metal Can Manufacturing*. <<http://www.census.gov/prod/ ec97/97m3324c.pdf>>.
U.S. Department of Commerce, Bureau of the Census. 1998. *1996 Annual Survey of Manufactures Statistics for Industry Groups and Industries*. <<http://www.census.gov/ prod/www/abs/manu-min.html>>.
U.S. Department of Commerce, Bureau of the Census. 1997. *1995 Annual Survey of Manufactures Statistics for Industry Groups and Industries*. <<http://www.census.gov/prod/www/abs/manu-min.html>>.
U.S. Bureau of Labor Statistics. National Employment, Hours, and Earnings—Metal Cans: Series ID eeu31341106. <<http://www.bls.gov>>. As obtained on August 27, 1999.

- C less spillage or breakage,
- C ease of storage at home or when traveling,
- C maintenance of soft drink carbonation, and
- C ease of recycling.

The ability to recycle aluminum cans is one reason why they continue to dominate other packaging alternatives in the carbonated soft drink (CSD) market, one of the largest segments of the market. CMI estimated that in 1998, two out of every three manufactured aluminum beverage cans were recycled as new cans, a process that takes approximately 60 days (CMI, 1999d). In 1997, aluminum cans accounted for 75.7 percent of the soft drink packaging mix followed by

Table 2-3. Metal Can Uses by Material and Type

Type	Material Used	Products Contained
Three-Piece Can Body	Steel	Food, juices, spices, aspirin, paints, glue, aerosols (includes decorative tins)
Two-Piece Can Body		
Draw-iron	Aluminum	Beer, carbonated beverages, juices
	Steel	Food, other nonfood
Draw/redraw	Steel, aluminum	Food, shoe polish, sterno, fuel, car wax, other nonfood products

Source: U.S. Environmental Protection Agency. 1998. "Preliminary Industry Characterization: Metal Can Manufacturing-Surface Coating." http://www.epa.gov/ttn/uatw/coat/mcan/met_can.htm.

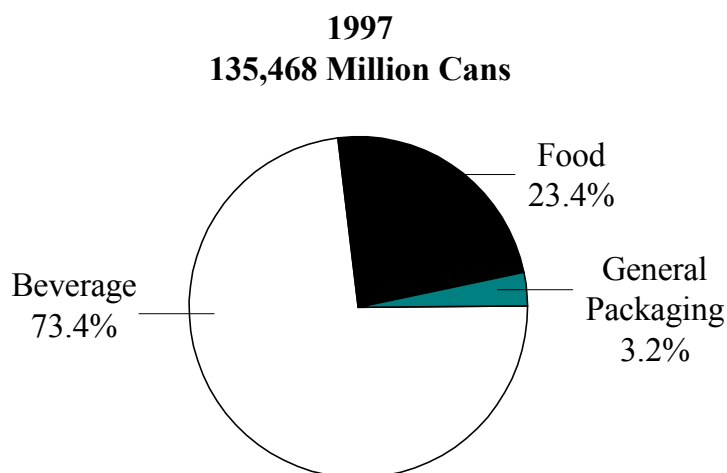


Figure 2-4. Distribution of Metal Can Shipments by End Use: 1997

Source: Can Manufacturers Institute (CMI). "Domestic Can Shipment 1997." <http://www.cancentral.com/foodstats.cfm>. Obtained August 31, 1999c.

plastic (19.9 percent), glass (2.3 percent), and other (2.1 percent) (see Figure 2-5). Despite the current dominance of aluminum beverage containers, the use of polyethylene terephthalate (PET) bottles has recently experienced growth due to the widespread availability of the polymer and its low cost (O'Neill, 1998). Aluminum cost increases in the mid-1990s encouraged soft drink canners to substitute bottles made of PET. The glass CSD container share, on the other hand, is small and declining. For example, the Census Bureau (1999a) reports shipments of glass bottles fell 14 percent from 1997 to 1998.

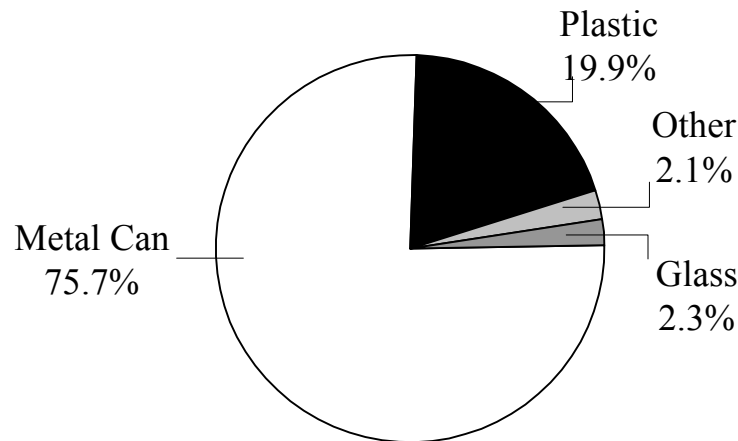


Figure 2-5. Distribution of Soft Drink Packaging Mix by Type: 1997

Source: Can Manufacturers Institute (CMI). "1997 Retail Sales Prove It's Better in Cans." *Canline* 1(2). <<http://www.cancentral.com/canline/vln2/vln2.htm>>. As obtained on August 31, 1999a.

Another important beverage segment is the beer market. Aluminum beer containers accounted for approximately one-third of metal can beverage shipments in 1999 (CMI, 2001a). Small aluminum cans (60 percent) and glass bottles (27 percent) dominate the beer market, with bulk packages such as kegs accounting for the remaining 13 percent (Brody and Marsh, 1997). Recently, plastic containers have entered the single-service beer market.

A variety of alternative packaging methods in the food/general packaging containers market exist. The primary factors in deciding which type of material to use in packaging are temperature control, counterpressure, and shelf-life, but in most cases plastic or glass can be substituted for metal (Brody, 2001).

Plastic containers have enjoyed widespread use since the 1970s, but this use has been concentrated in the beverage market. In 1998, only about 1 billion plastic containers were used in food packaging versus 32 billion metal containers (Brody, 2001). Steel food can manufacturers have primarily been affected by the increasing use of plastic in a limited number of food market segments as they face increased competition from microwave and frozen food products using plastic packaging (Hillstrom, 1994). Plastic also has the advantage of being impact resistant, heat resistant, and transparent. PET is often used as a glass replacement in both food and beverage bottles (Brody and Lord, 2000).

Glass is also used in food packaging. It is usually found in the form of wide mouth containers (i.e., jars). Approximately one half of glass containers are used for baby food. Glass is much more prevalent in the food packaging industry than is plastic (approximately nine times more glass containers are used) (Brody, 2001). Although consumers desire the transparency of glass, it might be less than desirable from the perspective of food preservation because light can accelerate reactions in the food.

Although it can be substituted for metal or plastic it is very heavy, breakable, and energy intensive to produce (Brody and Lord, 2000).

Paper and paperboard are the most widely used package materials in the world. However, in order to protect food from moisture, gas, odors, or microorganisms, they must first be coated with plastic. For this reason, they are infrequently used as substitutes for glass, plastic, and metal in the food and beverage industry (Brody and Lord, 2000).

Prices of raw materials can significantly influence beverage producers' choice of container material because containers represent a large share of the product's cost and because several substitute materials exist.⁴ For example, aluminum can prices increased nearly 14 percent between 1994 and 1995, leading several manufacturers to consider expansion of plastic packaging methods (Sfiligoj, 1995).

In addition to this anecdotal evidence, there is some quantitative data suggesting substitution between container materials based on relative prices. Aluminum can shipments in the beverage market declined by 5 billion units, or 4.6 percent, from 1994 to 1995, as aluminum can prices rose relative to PET bottles. Since 1995, the price of aluminum cans has fallen relative to PET, and shipments of aluminum cans have risen close to 1994 levels. A simple regression of the ratio of aluminum and PET prices on shipments of aluminum cans provides an elasticity estimate of -0.6 .⁵ In other words, a 1 percent increase in the price of aluminum cans relative to PET bottles is estimated to reduce the quantity of aluminum cans demanded by 0.6 percent.

Although the cost of steel cans has remained constant over this period, sharp reductions in raw steel prices in 2000 and 2001 suggest lower costs of steel cans in the future. However, in addition to declines in metal prices, plastic resin costs have fallen since 1995, which makes plastic containers more attractive (O'Neill, 1998). In fact, all of the major materials used in food and beverage packaging (aluminum, steel, plastic, and glass) have been declining in price over the last few years in inflation-adjusted terms.

2.3 Industry Organization

This section provides an overview of the market structure of the metal can manufacturing industry, including the facilities, the companies that own them, and the markets in which they compete.

2.3.1 Market Structure

Market structure is of interest because it determines the behavior of producers and consumers in the industry. If an industry is perfectly competitive, then individual producers are not able to influence the price of the output they sell or the inputs they purchase. This condition is most likely to hold if the industry has a large number of firms, the products sold and the inputs purchased are homogeneous, and

⁴Economic theory suggests the elasticity of the derived demand for an input is a function of the cost share of the input in total production cost and the elasticity of substitution between this input and other inputs in production (Hicks, 1966). Because the cost share of containers is relatively large and there are good substitutes available, we may infer an elastic demand for aluminum beverage cans. Containers used in food or general packaging applications (e.g., steel cans) typically have much smaller cost shares than those used for beverages (because the products contained in them often have far higher values than beverages) and would be expected to face less elastic demand curves.

⁵The model estimated was $\ln Q_{Al} = a + b \ln \left(\frac{P_{PET}}{P_{Al}} \right)$, where Q_{Al} is the quantity of

aluminum cans; P_{PET} and P_{Al} are inflation-adjusted price indices of PET bottles and aluminum cans, respectively; and a and b are parameters to be estimated.

entry and exit of firms are unrestricted. Entry and exit of firms are unrestricted for most industries except, for example, in cases where government regulates who is able to produce, where one firm holds a patent on a product, where one firm owns the entire stock of a critical input, or where a single firm is able to supply the entire market.

Four- and eight-firm concentration ratios (CR4 and CR8, respectively) and Herfindahl-Hirschmann indexes (HHIs) can provide some insight into the competitiveness of an industry. The U.S. Department of Commerce reports these ratios and indices by NAICS codes for 1997, the most recent year available. Values for the metal can industry, glass containers industry, and plastic bottle industry are reported in Tables 2-4, 2-5, and 2-6, respectively.

Table 2-4. Measures of Market Concentration for the Metal Cans Industry (NAICS 332431): 1997

Value of Shipments (\$10 ⁶)	CR4	CR8	HHI
\$11,930	58%	87%	1,180

Notes: CR4 denotes four-firm concentration ratio.
CR8 denotes eight firm concentration ratio.
HHI denotes Herfindahl-Hirschmann index for 50 largest companies.

Source: U.S. Department of Commerce, Bureau of the Census. 2001. *Concentration Ratios in Manufacturing*. <<http://www.census.gov/prod/ec97/m31s-cr.pdf>>.

Table 2-5. Measures of Market Concentration for the Glass Containers Industry (NAICS 327213): 1997

Value of Shipments (\$10 ⁶)	CR4	CR8	HHI
\$4,198	91%	98%	2960

Notes: CR4 denotes four-firm concentration ratio.
CR8 denotes eight firm concentration ratio.
HHI denotes Herfindahl-Hirschmann index for 50 largest companies.

Source: U.S. Department of Commerce, Bureau of the Census. 2001. *Concentration Ratios in Manufacturing*. <<http://www.census.gov/prod/ec97/m31s-cr.pdf>>.

Table 2-6. Measures of Market Concentration for the Plastic Bottle Industry (NAICS 326160): 1997

Value of Shipments (\$10 ⁶)	CR4	CR8	HHI
\$6,335	33%	52%	425

Notes: CR4 denotes four-firm concentration ratio.
CR8 denotes eight firm concentration ratio.
HHI denotes Herfindahl-Hirschmann index for 50 largest companies.

Source: U.S. Department of Commerce, Bureau of the Census. 2001. *Concentration Ratios in Manufacturing*. <<http://www.census.gov/prod/ec97/m31s-cr.pdf>>.

The criteria for evaluating the HHIs are based on the 1992 Department of Justice's Horizontal Merger Guidelines. According to these criteria, industries with HHIs below 1,000 are considered unconcentrated (i.e., more competitive), those with HHIs between 1,000 and 1,800 are considered moderately concentrated (i.e., moderately competitive), and those with HHIs above 1,800 are considered highly concentrated (i.e., less competitive). In general, firms in less-concentrated industries are more likely to be price takers, while firms in more-concentrated industries are more likely to be able to influence market prices.

In the metal can industry, the CR4 was 58 percent, while the CR8 was 87 percent. The HHI for this industry was 1,180. Based on the criteria above, the metal can industry can be classified as moderately concentrated.

With only 11 companies, the glass container industry was concentrated with a CR4 of 91 percent and a CR8 of 98 percent. The HHI for this industry implies that it was highly concentrated.

In the plastic bottle industry, the CR4 was 33 percent and the CR8 was 52 percent. With an HHI of 425, the plastic bottle industry can be classified as unconcentrated.

Although the metal can industry appears to fall at the lower end of the moderately concentrated range, the close substitutability of alternative materials such as glass and plastic makes it likely that metal can producers behave as price-takers. Thus, based on the CR4, CR8, HHI, and the available substitutes, an assumption of perfect competition for the metal can industry appears reasonable for modeling purposes.

2.3.2 Facilities

In the baseline for this analysis, 202 potentially affected facilities manufactured metal cans, sheets, or ends in the United States.⁶ These facilities can be classified as one of two types of producers: independent can manufacturers and captive can manufactures. Independent can producers coat and fabricate cans based on the customer's specified end use. Several of these plants manufacture cans solely for one customer (EPA, 1998). Captive can producers coat and fabricate cans as part of the vertical operations of a parent corporation. The great majority of metal cans are produced by independent can producers rather than for captive use (see Section 2.3.2 for more information).

The size of can manufacturing plants varies depending on the number and types of production processes performed. Some plants coat only the metal sheets, while others may fabricate a particular type of can body or end from the coated sheets. Others both coat and fabricate the metal can.

Metal can manufacturing facilities are generally located near sources of material supply (i.e.,

⁶That is, there were 202 facilities classified in the metal can manufacturing industry. However, eight of these facilities are classified as synthetic minor sources and 52 as area sources, neither of which incur any compliance costs under this regulation.

steel or aluminum plants) or near the customers based on the costs associated with transporting raw materials and final products. Figure 2-6 shows the distribution of these facilities across the United States. California contains the most metal can, sheet, or end manufacturing facilities (29), followed by Ohio (19), Illinois (15), and Wisconsin (13).

2.3.3 Companies

Thirty parent companies own the 202 metal can manufacturing facilities. These companies report an average (median) annual sales of \$3.8 billion (\$336 million). This figure includes revenue from operations other than metal can manufacturing. The average (median) employment for these companies was 17,400 (2,566) workers. Three of the largest companies, based on annual sales, produce containers as part of the company's vertical operations (i.e., Nestle S.A.—\$52.1 billion, Con Agra—\$23.8 billion, and H.J. Heinz Company—9.3 billion). However, these companies own a total of only seven facilities, or 3.5 percent of the establishments. *Ward's Business Directory* (Gale Research, 1999) identifies the top metal can manufacturing companies (i.e., those with

NAICS 332431 as a primary SIC) as Crown Cork and Seal Company (\$8.3 billion), Ball Corporation (\$2.8 billion), and American National Can Company (\$2.4 billion), all of which are independent metal can manufacturers. These companies own 82 facilities, or 43 percent of the

total. Additionally, Silgan Holdings Company is a major independent metal can manufacturer in this market: they own 34 facilities (annual sales are \$1.7 billion).

Metal can coating companies can be classified as small or large businesses using Small Business Administration (SBA) general size standard definitions for NAICS codes. For NAICS 332431, the SBA

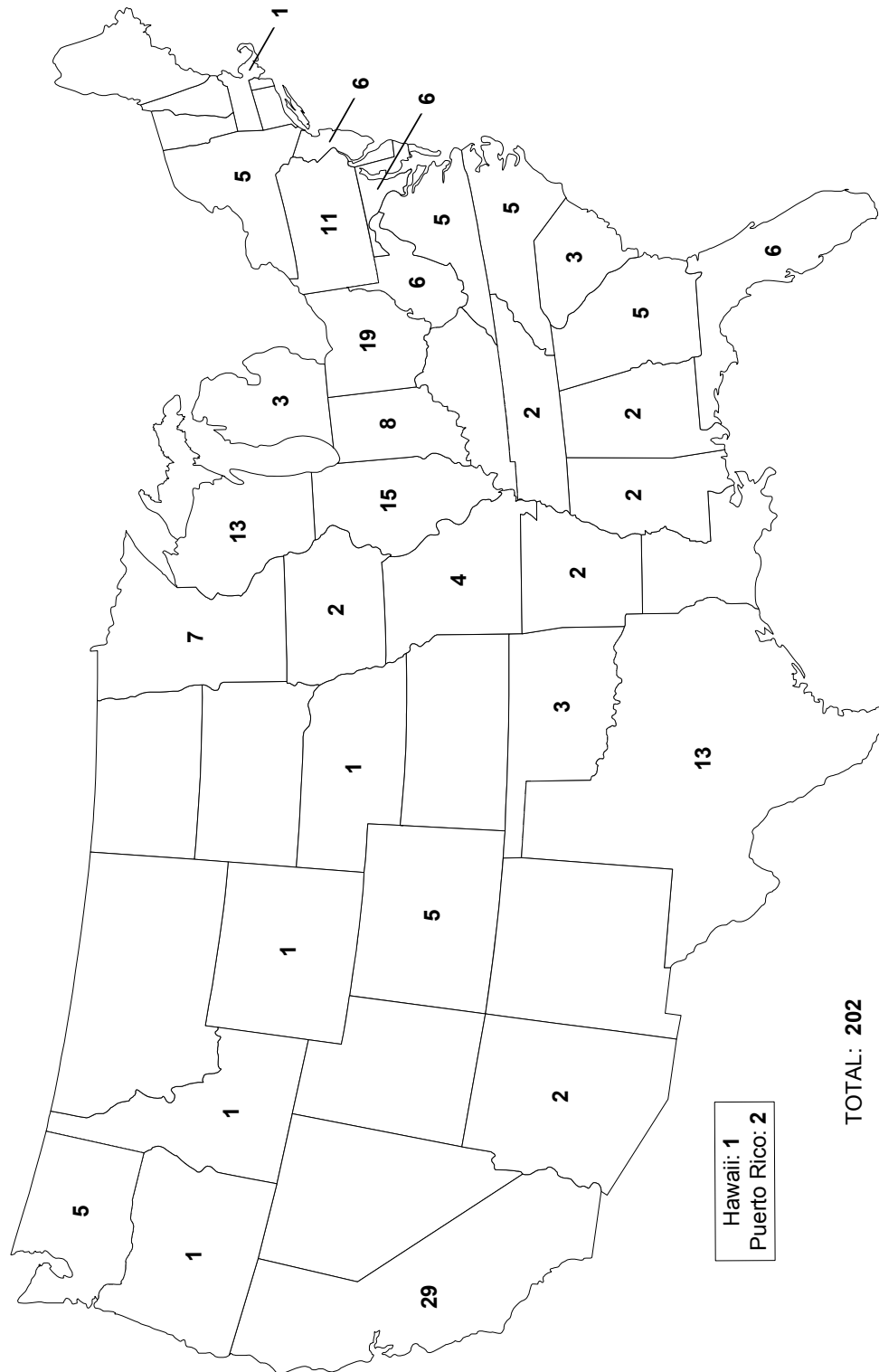


Figure 2-6. Distribution of Metal Can, Sheet, or End Manufacturing Facilities by State

defines a business as small if it employs 1,000 or fewer employees. Using this guideline and available secondary data, the Agency identified 13 small businesses, or 43.3 percent of the metal can companies. For these small businesses, the average (median) annual sales for companies reporting data were \$27 (\$24) million, and the average (median) employment was 178 (175) employees. Appendix A lists individual metal can companies and includes sales and employment data reported by secondary sources, including Dun & Bradstreet (1999), Hoover's Inc. (1999), and company and industry websites.

2.4 Market Data and Trends

Growth in the metal can industry during the 1990s has slowed as a result of a mature domestic market for aluminum and steel cans. As shown in Table 2-7, domestic shipments were reported at 137 billion cans in 1997 (baseline year), a small increase of 1.2 percent over 1996. During the period 1993 to 1999, total metal can shipments increased at an average annual rate of 1 percent.

There are a variety of metal can products, and prices vary by size and end-use application. The Agency conducted a search for can price data by type of can and found that this information is not published in a statistical annual. However, an industry trade journal did report spot prices for aluminum and steel beverage cans as well as plastic bottles for 1995 (Sfiligoj, 1995). Using these spot prices and the producer price indexes published by the BLS, the Agency computed a historical price time series for these selected cans for the period 1993 through 2000. As shown in Table 2-8, the average prices per 1,000 units during this period were as follows: aluminum cans (\$62.47), steel cans (\$65.28), and plastic bottles (\$68.51).

**Table 2-7. Domestic Metal Can Shipments by Market: 1993-1999
(million cans)**

Year	Beverage	Food	General Packaging	Total
1993	97,605	30,465	4,072	132,142
1994	103,119	31,907	4,228	139,254
1995	98,116	31,313	4,275	133,704
1996	99,136	31,971	4,361	135,468
1997	100,680	31,998	4,375	137,137
1998	102,789	31,782	4,404	138,975
1999	102,253	32,349	4,457	139,059
Average Annual Growth Rates				
1993-1999	1%	1%	2%	1%

Source: Can Manufacturers Institute (CMI). "Historical CMI Can Shipments." <<http://www.cancentral.com/>>. As obtained on December 6, 2001a.

Currently, foreign trade does not represent a significant share of metal can shipments. For 1996, the value of imports and exports as a share of the total value of shipments for NAICS 332431 was less than 1.5 percent. However, foreign interest in the benefits of aluminum can packaging is growing and this is expected to benefit U.S. producers of aluminum cans (Hillstrom, 1994). There has been growth in exports since 1992, although exports peaked in 1995 and have generally been declining since then (see Table 2-9). Similarly, imports (primarily from Canada) have risen between 1992 and 2000 but peaked in 1996 and have been on a downward trend. It is unclear why trade spiked in the mid-1990s and has since been falling. Even in the peak years, trade was a very small fraction of total production and consumption of metal cans. Because imports and exports are such a small percentage of total shipments, apparent consumption of metal cans in the U.S. does not differ greatly from total shipments

by domestic producers (see Table 2-9).

Table 2-8. Prices for Beverage Containers: 1993-2000 (\$/1,000 cans)
Table 2-9. Apparent Consumption of Metal Cans (NAICS 332431):
1993-1999 (million cans)

Year	Aluminum Cans	Steel Cans	PET Bottles	Apparent Consumption
Shipments by Domestic Manufacturers	Imports	Exports	NA	
1993	\$62.99	\$64.78		
1994	N/A \$61.01	3 \$64.78	395 \$65.23	N/A
1995	132,142 \$70.58	461 \$65.66	568 \$70.68	132,035
1996	139,254 \$63.02	711 \$65.81	1,390 \$68.57	138,575
1997	133,704 \$60.94	559 \$65.76	2,196 \$68.63	132,067
1998	135,468 \$61.01	1,454 \$65.76	899 \$67.73	136,023
1999	137,137 \$59.14	627 \$65.30	967 \$67.99	138,342
2000	139,000 \$60.04	634 \$64.37	624 \$70.75	139,126
Average	N/A \$62.47	634 \$65.28	674 \$68.51	N/A

Average Annual Growth Rates

Sources: Sfiligoi, Eric. June 1995. "At What Price?" <i>Beverage World</i> . 21%	1%
U.S. Bureau of Labor Statistics. Producer Price Index—Commodities: Aluminum Cans—Series ID wpul03103. < http://www.bls.gov/ >. As obtained on December 6, 2001a.	
Sources: U.S. International Trade Commission. ITC Trade Data Web. Version 2.4	
U.S. Bureau of Labor Statistics. Producer Price Index—Commodities: Steel Cans—Series ID wpul03102. < http://www.bls.gov/ >. As obtained on December 6, 2001b.	
U.S. Bureau of Labor Statistics. Producer Price Index—Commodities: Plastic Bottles—Series ID wpul03103. < http://www.bls.gov/ >. As obtained on December 6, 2001c.	
U.S. International Trade Commission. ITC Trade Data Web. Version 2.4. < http://www.bls.gov/ >. As obtained on December 7, 2001.	

Can Manufacturers Institute (CMI). "Historical CMI Can Shipments." <<http://www.cancentral.com/>>. As obtained on December 6, 2001a.

In the domestic market, the aluminum container has become widely used because of its relative advantages in price and weight as well as opportunities consumers have to recycle it. The beverage market grew rapidly during the 1980s and 1990s and began to dominate the entire can industry. Aluminum has a 75 percent market share in the beverage segment, experiencing rapid growth along with the beverage industry. As beverage industry growth has leveled off, so have sales of aluminum cans. Although steel represents a declining share of the beverage market, steel cans still dominate the food and consumer product markets. However, they face increased competition from food product packaging using plastic materials. Exports of both food and beverage products are anticipated to increase based on trends established during the 1990s. For example, between 1990 and 1992 soft drink and carbonated water exports increased 63 percent and fruit and vegetable exports increased approximately 32 percent (Hillstrom, 1994). However, it is not clear that these trends will lead to increased exports of metal cans. Because of the low value-to-weight ratio of metal cans, it appears unlikely that foreign trade in cans will develop to a significant degree. On the other hand, an increase in food and beverage exports may lead to an increase in demand for metal cans since they may be used to package the exported items.

SECTION 3 ENGINEERING COSTS

This section presents the Agency's estimates of the compliance costs associated with the regulatory alternatives developed to reduce HAP emissions during metal can coating operations. This NESHAP will limit the amount of organic HAP emitted relative to the volume of coating applied. To meet the requirements of this regulation, most facilities will add control devices, with some facilities substituting low- or no-HAP coatings for their current coatings. The tabular costs associated with making these changes to the metal can production process were estimated for the 142 major source facilities operating in the U.S. in the baseline year, 1997. These costs are defined as the annual recordkeeping and reporting, material, capital, and monitoring costs assuming no behavioral market adjustment by producers or consumers. The engineering costs will serve as an input to the economic model, which incorporates behavioral adjustments, presented in Section 4. An overview of the methodology used to develop the engineering cost estimates is provided below. A more detailed discussion of this methodology and the assumptions used for the calculations can be found in Icenhour (2002).

3.1 Methodology

EPA identified three potential types of costs associated with pollution abatement:

(1) monitoring, recordkeeping, and reporting (MR&R) costs, (2) material costs, and (3) capital costs related to the purchase and installation of add-on capture and control devices. Each of the cost components is briefly described below.

3.1.1 Monitoring, Recordkeeping, and Reporting Costs

MR&R costs are divided into six types, including the cost of labor to track material usage and to compile data for compliance reports; the cost of buying and maintaining computer equipment to track coating and solvent material usage; the cost associated with buying and maintaining continuous parameter monitoring systems for the add-on control devices; the cost of photocopying and mailing the reports and notifications; the cost of purchasing filing cabinets for recordkeeping purposes; and the cost of hiring a contractor to conduct performance testing of the add-on control devices and monitoring systems. The average annual total facility cost associated with MR&R activities is estimated to be \$52,700, for an industry total of \$7.3 million. Facilities that are subject to multiple subcategories have this MR&R cost divided evenly among the subcategories such that their total facility cost is \$52,700.

3.1.2 Material Costs

This cost component characterizes the of costs of substituting low- or no-HAP coatings for the coatings currently being used. For this analysis, EPA assumed that facilities in well-controlled subcategories such as two-piece beverage cans, two-piece food cans, and sheetcoating operations will meet HAP emission limits by installing a new regenerative thermal oxidizer (RTO) rather than incurring material costs. In addition, three facilities that are within 10 percent of the organic HAP emission rate for the well-controlled coating type segments were assumed to meet the limits by improving the existing capture device. All other subcategories, except for one-piece aerosol can facilities, are assumed to reformulate the coatings to limit surface coating HAP emissions.

Because reformulation costs vary by type of coating, the Can Manufacturers Institute (CMI) was consulted for accurate cost ranges. Based on these data, an average cost was estimated for each specific coating type segment. Costs were calculated using the assumption that each facility will use the same amount of coatings that were consumed in the baseline year of 1997 and that there will be a greater cost per gallon for low- or no-HAP coatings compared to the cost per gallon for higher HAP-content coatings. This incremental cost increase is assumed to be \$2.00 per gallon for inside sprays and \$5.00 per gallon for side seam stripes, which are used in three-piece food can assembly and three-piece nonfood can assembly subcategories, and \$2.00 per gallon for non-aseptic end seal compounds, which are used in the end lining operations subcategory. The total estimated impact for material costs is estimated to be \$4.1 million per year for the three impacted subcategories.

3.1.3 Add-On Control Devices

In general, the two-piece beverage cans, two-piece food cans, and sheetcoating subcategories are well-controlled in terms of air emissions. Therefore, EPA assumed that all facilities in these subcategories will require an RTO to meet the emission limit with two exceptions. First, if the facility has an organic HAP emission rate that is less than or equal to the organic HAP emission rate for the coating type segment, the amount of control is considered sufficient. Second, if the facility has an organic HAP emission rate that is less than 10 percent above the organic HAP emission rate for the coating type segment, it is assumed that the facility can meet the limit by adding equipment to the existing capture equipment. The capital cost for this investment is estimated to be \$400,000, which, when annualized over 10 years at 7 percent, is an annualized cost of \$98,000. For all other major source facilities, facility-specific capital equipment costs were estimated that include purchase, installation, and operation of an RTO. Capital investment costs were annualized over a 10-year period with an interest rate of 7 percent. The total annualized capital cost for all facilities is estimated to be \$44.8 million.

3.2 Engineering Cost Summary

The Agency's facility level engineering cost estimates are summarized in Table 3-1 for each of the 142 major sources and 8 synthetic minor sources in the metal can manufacturing industry. The nationwide total cost is estimated at \$56.2 million per year divided across 142 major source facilities. This cost is divided among MR&R costs of \$7.3 million, material costs of \$4.1 million, and capital costs for add-on control devices of \$44.8 million.

Table 3-1. Summary of Costs to Industry Subcategories/Segments

Blind FACID	Subcategory	Floor Facility	Synthetic		Number of APCDs	Annual Material Costs	Annualized Capital Costs	Annual MR&R Costs	Total Annualized Costs
26	Nonaseptic side seam stripe (food)		Yes			\$0	\$0	\$0	\$0
137	Nonaseptic side seam stripe (food)		Yes			\$0	\$0	\$0	\$0
84	Nonaseptic end seal compounds					\$141,316	\$0	\$52,700	\$194,016
89	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
65	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
48	Beverage can coatings				1	\$0	\$738,922	\$52,700	\$791,622
130	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
112	Beverage can coatings				1	\$0	\$285,739	\$52,700	\$338,439
118	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
144	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
140	Nonaseptic end seal compounds					\$0	\$0	\$0	\$0
108	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
101	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
58	Beverage can coatings					\$0	\$387,340	\$52,700	\$440,040
117	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
106	Beverage can coatings				2	\$0	\$440,603	\$52,700	\$493,303
37	Beverage can coatings				1	\$0	\$330,613	\$52,700	\$383,313
163	Beverage can coatings	Yes			1	\$0	\$0	\$52,700	\$52,700
158	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
30	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
70	Beverage can coatings					\$0	\$341,897	\$52,700	\$394,597
83	Aseptic side seam stripe (Food)	Yes				\$6,071	\$0	\$26,350	\$32,421
83	Nonaseptic side seam stripe (Food)					\$66,831	\$0	\$26,350	\$93,181
59	Aseptic side seam stripe (Food)					\$57,150	\$0	\$26,350	\$83,500
59	Nonaseptic side seam stripe (Food)					\$71,693	\$0	\$26,350	\$98,043
190	Aseptic end seal compounds	Yes				\$0	\$0	\$17,567	\$17,567
190	Nonaseptic side seam stripe (Food)					\$74,100	\$0	\$17,567	\$91,667
190	Sheetcoatings				1	\$0	\$316,847	\$17,567	\$334,414

(continued)

Table 3-1. Summary of Costs to Industry Subcategories/Segments (Continued)

Blind FACID	Subcategory	Floor Facility	Synthetic Minor	Small Business	Number of APCDs	Annual Material Costs	Annualized Capital Costs	Annual MR&R Costs	Total Annualized Costs
121	Aseptic side seam stripe (Food)	Yes				\$0	\$0	\$0	\$0
121	Nonaseptic side seam stripe (Food)					\$0	\$0	\$0	\$0
47	Aseptic end seal compounds	Yes				\$0	\$0	\$17,567	\$17,567
47	Aseptic side seam stripe (Food)					\$12,360	\$0	\$17,567	\$29,927
47	Nonaseptic side seam stripe (Food)					\$28,095	\$0	\$17,567	\$45,662
22	Nonaseptic end seal compounds					\$751,936	\$0	\$26,350	\$778,286
22	Sheetcoatings				2	\$0	\$689,944	\$26,350	\$716,294
80	Beverage can coatings					\$0	\$387,340	\$26,350	\$413,690
80	Nonaseptic end seal compounds	Yes				\$0	\$0	\$26,350	\$26,350
78	Beverage can coatings					\$0	\$387,340	\$52,700	\$440,040
67	Beverage can coatings					\$0	\$193,670	\$17,567	\$211,237
67	Food can coatings					\$0	\$193,670	\$17,567	\$211,237
67	Nonaseptic end seal compounds	Yes				\$0	\$0	\$17,567	\$17,567
162	Beverage can coatings				1	\$0	\$407,242	\$52,700	\$459,942
159	Beverage can coatings				1	\$0	\$334,679	\$52,700	\$387,379
123	Beverage can coatings				1	\$0	\$360,074	\$52,700	\$412,774
72	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
32	General line side seam stripe (nonfood)					\$0	\$0	\$17,567	\$17,567
32	Nonaseptic end seal compounds					\$34,916	\$0	\$17,567	\$52,483
32	Sheetcoatings				1	\$0	\$220,948	\$17,567	\$238,515
66	Aerosol side seam stripe (nonfood)					\$5,505	\$0	\$13,175	\$18,680
66	Aseptic end seal compounds					\$0	\$0	\$13,175	\$13,175
66	Nonaseptic end seal compounds					\$2,202	\$0	\$13,175	\$15,377
66	Sheetcoatings				3	\$0	\$351,586	\$13,175	\$364,761
183	General line side seam stripe (nonfood)					\$0	\$0	\$26,350	\$26,350
183	Sheetcoatings	Yes			1	\$0	\$0	\$26,350	\$26,350
43	Sheetcoatings	Yes			3	\$0	\$0	\$52,700	\$52,700

(continued)

Table 3-1. Summary of Costs to Industry Subcategories/Segments (Continued)

Blind FACID	Subcategory	Floor Facility	Synthetic Minor	Small Business	Number of APCDs	Annual Material Costs	Annualized Capital Costs	Annual MR&R Costs	Total Annualized Costs
16	Inside spray	Yes	Yes	Yes	1	\$0	\$0	\$0	\$0
16	Nonaseptic end seal compounds		Yes	Yes		\$0	\$0	\$0	\$0
16	Nonaseptic side seam stripe (Food)		Yes	Yes	1	\$0	\$0	\$0	\$0
16	Sheetcoatings		Yes	Yes	1	\$0	\$0	\$0	\$0
115	Aerosol can coatings	Yes			2	\$0	\$0	\$52,700	\$52,700
44	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
189	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
62	Nonaseptic end seal compounds					\$249,447	\$0	\$52,700	\$302,147
200	Aseptic end seal compounds					\$0	\$0	\$13,175	\$13,175
200	Inside spray					\$19,250	\$0	\$13,175	\$32,425
200	Nonaseptic side seam stripe (Food)					\$22,275	\$0	\$13,175	\$35,450
200	Sheetcoatings				1	\$0	\$283,685	\$13,175	\$296,860
110	Aerosol side seam stripe (nonfood)	Yes				\$0	\$0	\$0	\$0
56	Sheetcoatings	Yes			3	\$0	\$97,556	\$52,700	\$150,256
136	Beverage can coatings	Yes			2	\$0	\$0	\$26,350	\$26,350
136	Nonaseptic end seal compounds					\$77,420	\$0	\$26,350	\$103,770
12	Food can coatings	Yes				\$0	\$360,074	\$52,700	\$412,774
164	Aerosol side seam stripe (nonfood)	Yes				\$0	\$0	\$17,567	\$17,567
164	Nonaseptic end seal compounds	Yes				\$0	\$0	\$17,567	\$17,567
164	Sheetcoatings				1	\$0	\$271,329	\$17,567	\$288,896
124	Beverage can coatings	Yes			1	\$0	\$296,040	\$52,700	\$348,740
202	Inside spray	Yes				\$7,040	\$0	\$26,350	\$33,390
202	Nonaseptic side seam stripe (Food)					\$26,443	\$0	\$26,350	\$52,793
28	Beverage can coatings	Yes			2	\$0	\$382,531	\$52,700	\$435,231
145	Aerosol side seam stripe (nonfood)					\$8,700	\$0	\$10,540	\$19,240
145	Aseptic end seal compounds					\$0	\$0	\$10,540	\$10,540
145	Nonaseptic end seal compounds	Yes				\$0	\$0	\$10,540	\$10,540

(continued)

Table 3-1. Summary of Costs to Industry Subcategories/Segments (Continued)

Blind FACID	Subcategory	Floor Facility	Synthetic Minor	Small Business	Number of APCDs	Annual Material Costs	Annualized Capital Costs	Annual MR&R Costs	Total Annualized Costs
145	Nonaseptic side seam stripe (Food)	Yes				\$275	\$0	\$10,540	\$10,815
145	Sheetcoatings				2	\$0	\$602,431	\$10,540	\$612,971
88	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
54	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
122	Sheetcoatings				1	\$0	\$333,108	\$52,700	\$385,808
27	Beverage can coatings					\$0	\$341,897	\$52,700	\$394,597
178	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
204	Aseptic end seal compounds	Yes				\$0	\$0	\$13,175	\$13,175
204	Inside spray	Yes				\$0	\$0	\$13,175	\$13,175
204	Nonaseptic side seam stripe (Food)					\$20,120	\$0	\$13,175	\$33,295
204	Sheetcoatings				2	\$0	\$283,685	\$13,175	\$296,860
107	Aerosol side seam stripe (nonfood)	Yes				\$0	\$0	\$13,175	\$13,175
107	Inside spray					\$4,180	\$0	\$13,175	\$17,355
107	Nonaseptic end seal compounds	Yes				\$0	\$0	\$13,175	\$13,175
107	Sheetcoatings				1	\$0	\$407,242	\$13,175	\$420,417
206	Inside spray	Yes				\$21,560	\$0	\$26,350	\$47,910
206	Nonaseptic side seam stripe (Food)					\$31,900	\$0	\$26,350	\$58,250
172	Aseptic end seal compounds	Yes				\$0	\$0	\$17,567	\$17,567
172	Nonaseptic end seal compounds					\$1,970	\$0	\$17,567	\$19,537
172	Sheetcoatings				2	\$0	\$571,264	\$17,567	\$588,831
134	Aseptic end seal compounds	Yes				\$0	\$0	\$13,175	\$13,175
134	Inside spray					\$35,200	\$0	\$13,175	\$48,375
134	Nonaseptic end seal compounds					\$3,441	\$0	\$13,175	\$16,616
134	Nonaseptic side seam stripe (Food)					\$29,425	\$0	\$13,175	\$42,600
132	Sheetcoatings				1	\$0	\$307,161	\$52,700	\$359,861
36	Sheetcoatings				1	\$0	\$252,795	\$52,700	\$305,495
40	Aerosol side seam stripe (nonfood)	Yes				\$0	\$0	\$17,567	\$17,567

(continued)

Table 3-1. Summary of Costs to Industry Subcategories/Segments (Continued)

Blind FACID	Subcategory	Floor Facility	Synthetic Minor	Small Business	Number of APCDs	Annual Material Costs	Annualized Capital Costs	Annual MR&R Costs	Total Annualized Costs
40	Nonaseptic end seal compounds	Yes				\$0	\$0	\$17,567	\$17,567
40	Sheetcoatings				2	\$0	\$250,744	\$17,567	\$268,311
52	Sheetcoatings		Yes			\$0	\$0	\$0	\$0
63	Beverage can coatings	Yes			1	\$0	\$0	\$52,700	\$52,700
8	Aseptic end seal compounds					\$0	\$0	\$13,175	\$13,175
8	Nonaseptic end seal compounds					\$0	\$0	\$13,175	\$13,175
8	Nonaseptic side seam stripe (Food)	Yes				\$9,010	\$0	\$13,175	\$22,185
8	Sheetcoatings				2	\$0	\$252,795	\$13,175	\$265,970
92	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
18	Nonaseptic end seal compounds					\$86,954	\$0	\$52,700	\$139,654
179	Beverage can coatings					\$0	\$360,074	\$26,350	\$386,424
179	Nonaseptic end seal compounds					\$93,866	\$0	\$26,350	\$120,216
20	Sheetcoatings				1	\$0	\$314,574	\$52,700	\$367,274
165	Nonaseptic side seam stripe (Food)	Yes				\$32,540	\$0	\$52,700	\$85,240
126	Nonaseptic end seal compounds					\$102,338	\$0	\$52,700	\$155,038
173	Food can coatings					\$0	\$360,074	\$52,700	\$412,774
127	Inside spray					\$25,120	\$0	\$17,567	\$42,687
127	Nonaseptic end seal compounds					\$44,770	\$0	\$17,567	\$62,337
127	Sheetcoatings			3		\$0	\$326,930	\$17,567	\$344,497
85	Beverage can coatings					\$0	\$387,340	\$52,700	\$440,040
21	Nonaseptic end seal compounds					\$0	\$0	\$26,350	\$26,350
21	Sheetcoatings			3		\$0	\$617,501	\$26,350	\$643,851
23	Sheetcoatings			2		\$0	\$602,473	\$52,700	\$655,173
203	Sheetcoatings			2		\$0	\$677,250	\$52,700	\$729,950
97	Sheetcoatings			4		\$0	\$476,988	\$52,700	\$529,688
53	Beverage can coatings			1		\$0	\$466,936	\$52,700	\$519,636
61	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774

(continued)

Table 3-1. Summary of Costs to Industry Subcategories/Segments (Continued)

Blind FACID	Subcategory	Floor Facility	Synthetic Minor	Small Business	Number of APCDs	Annual Material Costs	Annualized Capital Costs	Annual MR&R Costs	Total Annualized Costs
79	Beverage can coatings				1	\$0	\$285,594	\$52,700	\$338,294
198	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
133	Beverage can coatings					\$0	\$387,340	\$52,700	\$440,040
82	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
57	Beverage can coatings				1	\$0	\$439,170	\$52,700	\$491,870
147	Beverage can coatings	Yes			1	\$0	\$97,556	\$52,700	\$150,256
2	Nonaseptic end seal compounds			Yes		\$22,166	\$0	\$52,700	\$74,866
171	Aseptic end seal compounds		Yes	Yes		\$0	\$0	\$0	\$0
171	Nonaseptic end seal compounds		Yes	Yes		\$0	\$0	\$0	\$0
201	Sheetcoatings			Yes		\$0	\$0	\$52,700	\$52,700
55	Aerosol can coatings			Yes	12	\$0	\$0	\$0	\$0
175	Aseptic end seal compounds		Yes	Yes		\$0	\$0	\$0	\$0
175	Nonaseptic end seal compounds	Yes	Yes	Yes		\$0	\$0	\$0	\$0
105	Beverage can coatings				1	\$0	\$405,080	\$52,700	\$457,780
135	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
150	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
77	Beverage can coatings				1	\$0	\$391,798	\$52,700	\$444,498
91	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
191	Nonaseptic end seal compounds					\$0	\$0	\$52,700	\$52,700
177	Beverage can coatings	Yes			1	\$0	\$0	\$52,700	\$52,700
120	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
34	Beverage can coatings					\$0	\$360,074	\$52,700	\$412,774
149	Beverage can coatings					\$0	\$360,074	\$26,350	\$386,424
149	Nonaseptic end seal compounds					\$0	\$0	\$26,350	\$26,350
199	Beverage can coatings				1	\$0	\$405,080	\$26,350	\$431,430
199	Nonaseptic end seal compounds					\$0	\$0	\$26,350	\$26,350
142	Beverage can coatings					\$0	\$341,897	\$52,700	\$394,597

(continued)

Table 3-1. Summary of Costs to Industry Subcategories/Segments (Continued)

Blind FACID	Subcategory	Floor Facility	Synthetic Minor	Small Business	Number of APCDs	Annual Material Costs	Annualized Capital Costs	Annual MR&R Costs	Total Annualized Costs
75	Beverage can coatings					\$0	\$341,897	\$52,700	\$394,597
194	Aseptic end seal compounds					\$0	\$0	\$17,567	\$17,567
194	Inside spray					\$19,620	\$0	\$17,567	\$37,187
194	Nonaseptic side seam stripe (Food)					\$34,825	\$0	\$17,567	\$52,392
160	Aseptic end seal compounds					\$0	\$0	\$13,175	\$13,175
160	Inside spray	Yes				\$0	\$0	\$13,175	\$13,175
160	Nonaseptic side seam stripe (Food)					\$5,950	\$0	\$13,175	\$19,125
160	Sheetcoatings				1	\$0	\$341,897	\$13,175	\$355,072
167	Nonaseptic side seam stripe (Food)					\$0	\$0	\$26,350	\$26,350
167	Sheetcoatings	Yes			2	\$0	\$97,556	\$26,350	\$123,906
139	Food can coatings					\$0	\$360,074	\$26,350	\$386,424
139	Nonaseptic end seal compounds					\$73,988	\$0	\$26,350	\$100,338
129	Sheetcoatings				1	\$0	\$406,505	\$52,700	\$459,205
205	Nonaseptic end seal compounds					\$41,884	\$0	\$17,567	\$59,451
205	Nonaseptic side seam stripe (Food)	Yes				\$105,730	\$0	\$17,567	\$123,297
205	Sheetcoatings					\$0	\$341,897	\$17,567	\$359,464
161	Nonaseptic end seal compounds					\$183,710	\$0	\$17,567	\$201,277
161	Nonaseptic side seam stripe (Food)					\$8,935	\$0	\$17,567	\$26,502
161	Sheetcoatings				2	\$0	\$333,108	\$17,567	\$350,675
157	Nonaseptic side seam stripe (Food)					\$0	\$0	\$26,350	\$26,350
157	Sheetcoatings				1	\$0	\$641,700	\$26,350	\$668,050
95	Nonaseptic end seal compounds					\$0	\$0	\$26,350	\$26,350
95	Sheetcoatings				1	\$0	\$286,825	\$26,350	\$313,175
192	Aseptic side seam stripe (Food)	Yes				\$0	\$0	\$17,567	\$17,567
192	Nonaseptic end seal compounds					\$85,594	\$0	\$17,567	\$103,161
192	Nonaseptic side seam stripe (Food)	Yes				\$34,515	\$0	\$17,567	\$52,082
184	Sheetcoatings				1	\$0	\$299,112	\$52,700	\$351,812

(continued)

Table 3-1. Summary of Costs to Industry Subcategories/Segments (Continued)

Blind FACID	Subcategory	Floor Facility	Synthetic Minor	Small Business	Number of APCDs	Material Costs	Annual Capital Costs	Annualized Costs	Annual MR&R Costs	Total Annualized Costs
143	Nonaseptic end seal compounds					\$57,644	\$0	\$0	\$26,350	\$83,994
143	Nonaseptic side seam stripe (Food)					\$7,685	\$0	\$0	\$26,350	\$34,035
25	Food can coatings					\$0	\$130,929	\$130,929	\$17,567	\$148,496
25	Nonaseptic end seal compounds					\$37,980	\$0	\$0	\$17,567	\$55,547
25	Sheetcoatings				1	\$0	\$130,929	\$130,929	\$17,567	\$148,496
195	Aseptic side seam stripe (Food)	Yes				\$0	\$0	\$0	\$17,567	\$17,567
195	Nonaseptic side seam stripe (Food)					\$26,180	\$0	\$0	\$17,567	\$43,747
195	Sheetcoatings				2	\$0	\$325,815	\$325,815	\$17,567	\$343,382
193	Nonaseptic end seal compounds					\$52,466	\$0	\$0	\$26,350	\$78,816
193	Sheetcoatings				2	\$0	\$362,841	\$362,841	\$26,350	\$389,191
93	Food can coatings					\$0	\$360,074	\$360,074	\$52,700	\$412,774
148	Aseptic side seam stripe (Food)	Yes				\$0	\$0	\$0	\$10,540	\$10,540
148	Food can coatings	Yes			1	\$0	\$352,071	\$352,071	\$10,540	\$362,611
148	Nonaseptic end seal compounds					\$345,200	\$0	\$0	\$10,540	\$355,740
148	Nonaseptic side seam stripe (Food)					\$179,500	\$0	\$0	\$10,540	\$190,040
148	Sheetcoatings				1	\$0	\$0	\$0	\$10,540	\$10,540
71	Food can coatings	Yes			1	\$0	\$0	\$0	\$13,175	\$13,175
71	Nonaseptic end seal compounds					\$41,884	\$0	\$0	\$13,175	\$55,059
71	Nonaseptic side seam stripe (Food)					\$11,970	\$0	\$0	\$13,175	\$25,145
71	Sheetcoatings					\$0	\$261,859	\$261,859	\$13,175	\$275,034
151	Aseptic end seal compounds					\$0	\$0	\$0	\$13,175	\$13,175
151	Food can coatings	Yes			1	\$0	\$0	\$0	\$13,175	\$13,175
151	Nonaseptic side seam stripe (Food)					\$11,970	\$0	\$0	\$13,175	\$25,145
151	Sheetcoatings					\$0	\$261,859	\$261,859	\$13,175	\$275,034
197	Nonaseptic end seal compounds					\$80,356	\$0	\$0	\$52,700	\$133,056
9	Sheetcoatings				4	\$0	\$1,668,097	\$1,668,097	\$52,700	\$1,720,797

(continued)

Table 3-1. Summary of Costs to Industry Subcategories/Segments (Continued)

Blind FACID	Subcategory	Floor Facility	Synthetic Minor	Small Business	Number of APCDs	Annual Material Costs	Annualized Capital Costs	Annual MR&R Costs	Total Annualized Costs
196	Sheetcoatings				4	\$0	\$666,836	\$52,700	\$719,536
100	Nonaseptic end seal compounds					\$148,008	\$0	\$52,700	\$200,708
119	Food can coatings				2	\$0	\$644,086	\$52,700	\$696,786
185	Nonaseptic end seal compounds					\$148,008	\$0	\$52,700	\$200,708
96	Food can coatings	Yes			1	\$0	\$0	\$17,567	\$17,567
96	Nonaseptic end seal compounds					\$54,774	\$0	\$17,567	\$72,341
96	Sheetcoatings					\$0	\$632,445	\$17,567	\$650,012
7	Sheetcoatings	Yes			1	\$0	\$0	\$52,700	\$52,700
68	Aerosol side seam stripe (nonfood)	Yes				\$11,000	\$0	\$13,175	\$24,175
68	General line side seam stripe (nonfood)	Yes				\$2,595	\$0	\$13,175	\$15,770
68	Nonaseptic end seal compounds					\$0	\$0	\$13,175	\$13,175
68	Sheetcoatings				2	\$0	\$670,553	\$13,175	\$683,728
19	Sheetcoatings					\$0	\$360,074	\$52,700	\$412,774
99	Sheetcoatings				1	\$0	\$270,131	\$52,700	\$322,831
11	General line side seam stripe (nonfood)	Yes	Yes			\$0	\$0	\$0	\$0
11	Nonaseptic end seal compounds		Yes			\$0	\$0	\$0	\$0
11	Sheetcoatings		Yes			\$0	\$0	\$0	\$0
103	Aerosol side seam stripe (nonfood)		Yes			\$0	\$0	\$0	\$0
103	General line side seam stripe (nonfood)	Yes	Yes			\$0	\$0	\$0	\$0
103	Nonaseptic end seal compounds		Yes			\$0	\$0	\$0	\$0
103	Sheetcoatings		Yes		1	\$0	\$0	\$0	\$0
181	Sheetcoatings				1	\$0	\$500,735	\$52,700	\$553,435

(continued)

Table 3-1. Summary of Costs to Industry Subcategories/Segments (Continued)

Blind FACID	Subcategory	Floor Facility	Synthetic Minor	Small Business	Number of APCDs	Annual Material Costs	Annualized Capital Costs	Annual MR&R Costs	Total Annualized Costs
42	Aerosol side seam stripe (nonfood)					\$34,650	\$0	\$13,175	\$47,825
42	General line side seam stripe (nonfood)	Yes				\$0	\$0	\$13,175	\$13,175
42	Nonaseptic end seal compounds					\$0	\$0	\$13,175	\$13,175
42	Sheetcoatings				1	\$0	\$514,615	\$13,175	\$527,790
116	Sheetcoatings	Yes			1	\$0	\$0	\$52,700	\$52,700
41	Sheetcoatings				12	\$0	\$1,787,523	\$52,700	\$1,840,223
180	General line side seam stripe (nonfood)	Yes				\$7,530	\$0	\$17,567	\$25,097
180	Nonaseptic end seal compounds					\$0	\$0	\$17,567	\$17,567
180	Sheetcoatings				1	\$0	\$495,670	\$17,567	\$513,237
141	Sheetcoatings				1	\$0	\$446,675	\$52,700	\$499,375
154	Sheetcoatings			Yes	1	\$0	\$525,227	\$52,700	\$577,927
38	Sheetcoatings				3	\$0	\$773,740	\$52,700	\$826,440
109	Sheetcoatings				3	\$0	\$567,451	\$52,700	\$620,151
155	Sheetcoatings			Yes	1	\$0	\$304,383	\$52,700	\$357,083
Totals		56	18	13	144	\$4,081,736	\$44,833,563	\$7,325,316	\$56,240,611

SECTION 4

ECONOMIC IMPACT ANALYSIS: METHODS AND RESULTS

The underlying objective of the EIA is to evaluate the effect of the proposed regulation on the welfare of affected stakeholders and society in general. Although the engineering cost analysis presented in Section 3 represents an estimate of the resources required to comply with the proposed rule under baseline economic conditions, that analysis does not account for the fact that the regulations may cause the economic conditions to change. For instance, producers may elect to reduce output in response to cost increases or even discontinue production rather than comply, thereby reducing market supply. Moreover, the control costs may be passed along to other parties through various economic exchanges. The purpose of this section is to develop and apply an analytical structure for measuring and tracking these effects as they are distributed across the stakeholders tied together through economic linkages.

4.1 Markets Affected by the Proposed NESHAP

The determination of markets potentially affected by the rule requires identifying the products produced at the affected facilities and linking them to markets where they are exchanged. Based on the Information Collection Request (ICR) and data provided by the Can Manufacturers Institute (CMI), EPA divided the metal can market into three separate markets:

- C beverage cans,
- C food cans, and
- C general packaging containers.

The economic impacts of the rule on the identified industries and related product markets are examined in the following sections using both a conceptual approach and operational model. The conceptual approach is described in Section 4.2, while Section 4.3 presents the economic impact results based on the operational model.

4.2 Conceptual Approach

The Agency developed three national partial equilibrium models to estimate the economic impacts on society resulting from the proposed regulation. The large number of metal can producers and the close substitutability of alternative materials such as glass and plastic for metal cans in many packaging applications lends support for the notion that metal can producers will behave as if they operate in perfectly competitive markets. As a result, we assume that the number of buyers and sellers is large enough that no individual buyer or seller has market power (i.e., influence on market prices). Under this condition, producers and consumers take the market price as a given when making their production and consumption choices.

4.2.1 Supply

After critical review, the Agency determined that the level of detail of facility survey and compliance cost data is sufficient to support a facility-level characterization of supply. EPA assumed each plant has some fixed factors of production (e.g., plant and equipment) that are augmented with variable factors inputs (e.g., materials, labor) to produce metal cans. These fixed factors are the source of diminishing marginal returns, hence, increasing marginal costs. Therefore each supply segment (beverage cans, food cans, general packaging containers) can be characterized by an upward-sloping supply curve.

An important measure of the magnitude of this response is the price elasticity of supply, computed as the percentage change in quantity supplied divided by the percentage change in price. Absent empirical estimates of the supply elasticity, we use assumed values of the supply elasticity in each of the relevant markets and perform a sensitivity analysis on those assumptions. The supply elasticity used to generate the primary impact estimates, which are presented in Section 4.3, is 1.0 for all three markets modeled. The sensitivity analysis presented in Appendix B examines the effects of varying the supply elasticity between 0.5 and 2.0.

4.2.2 Demand

Consumption choices are a function of the price of the commodity, income, prices of related goods, tastes, and expectations about the future, among other variables. In this analysis, we will consider how purchases of metal cans change in response to higher prices resulting from regulation, holding other variables constant. The demand for metal cans is a derived demand, meaning that the quantity of cans demanded is directly dependent on consumer demand for the final products metal cans are used to produce. In this case, consumer demand for products such as beverages, food, and paint influences the number of containers (e.g., metal, glass, or plastic) that will be purchased for packaging those products. Nonetheless, the price of factors of production, such as metal cans, is still an important determinant of the derived demand for that factor because of substitution possibilities among factors of production. The economic model assumes a downward sloping demand curve (i.e., the quantity demanded for a good falls when price rises), consistent with the Law of Demand. Thus, an increase in the price of metal cans, as is expected to occur following regulation, is expected to result in a decrease in the number of metal cans demanded by final product industries. The buyers of metal cans are likely to switch to containers made from alternative materials (e.g., plastic, glass) to some degree and/or reduce their total output in response to this increase in metal can costs.

EPA modeled the demand for metal cans in each of the three markets defined above based on using reasonable assumptions for the price elasticity of demand in each market. The primary consideration that will influence the choice of demand elasticity in each market is the availability of substitutes for metal cans in that market. Other things being equal, the more close substitutes are available for a given product, the more elastic the demand for that product. The more elastic demand arises because, with many close substitutes available, consumers can easily switch to alternative products in response to a price increase. As a result, manufacturers may have little ability to pass costs onto consumers in the form of price increases. In contrast, firms in industries with few close substitutes are likely to be able to pass a higher proportion of regulatory costs to consumers of their products.

Based on information contained in the metal cans industry profile, it appears that both metal food cans and metal beverage cans have fairly strong substitutes available (primarily plastic bottles for beverages and glass bottles for foods), while there are fewer substitutes for metal general packing containers in the markets where they are generally used (e.g., paint cans). In addition, the demand for aluminum beverage cans is likely to be more elastic than the demand for steel food cans because the cost share of cans in the beverage market is lower than in the food and general packaging markets and plastic bottles seem to be more generally substitutable for aluminum beverage cans than glass bottles for steel food cans. Consistent with this notion, Palmer, Sigman, and Walls (1996) report demand elasticities of -1.4 for aluminum beverage cans and -0.63 for steel cans (including both food cans and general packaging containers). EPA used these elasticities as the primary elasticity values for the economic analysis. However, because of the inherent uncertainty involved in selecting point estimates of demand elasticities, a sensitivity analysis was performed that examines the effects on the economic impact estimates of different assumptions concerning the demand elasticities. We examined a range of demand elasticities from -0.5 to -2 for each of the three affected markets as part of the sensitivity analysis, the results of which are presented in Appendix B.

4.2.3 Foreign Trade

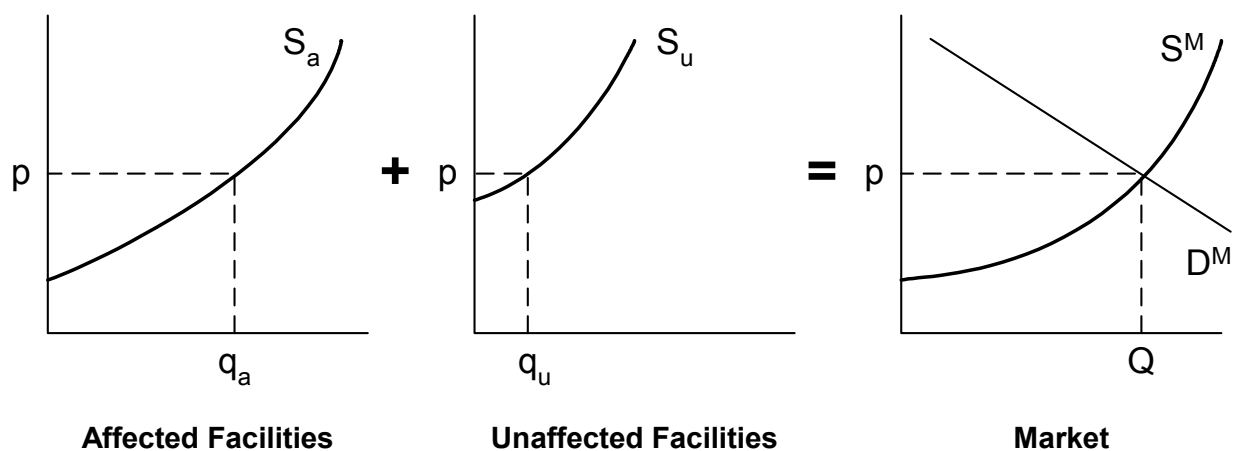
A review of the international trade data shows that foreign trade is a very small share of the domestic metal can market. Based on recent data, imports account for about 0.24 percent of 1998 U.S. metal can consumption and exports account for about 0.71 percent of 1998 U.S. metal can production. In addition, there is no information available to inform the allocation of imports and exports between the three markets defined above for the analysis. As a result, we provide a qualitative description of the foreign trade impacts rather than developing quantitative estimates. For example, foreign imports may become more attractive to U.S. consumers and U.S. exports may become less attractive to foreign consumers as a result of the change in relative prices resulting from regulation in the U.S. In addition, domestic facilities could potentially relocate to foreign countries with less stringent environmental regulations if domestic production costs increase.⁷ However, the cost impacts are unlikely to be large enough to cause significant trade impacts.

4.2.4 Baseline and With-Regulation Market Equilibrium

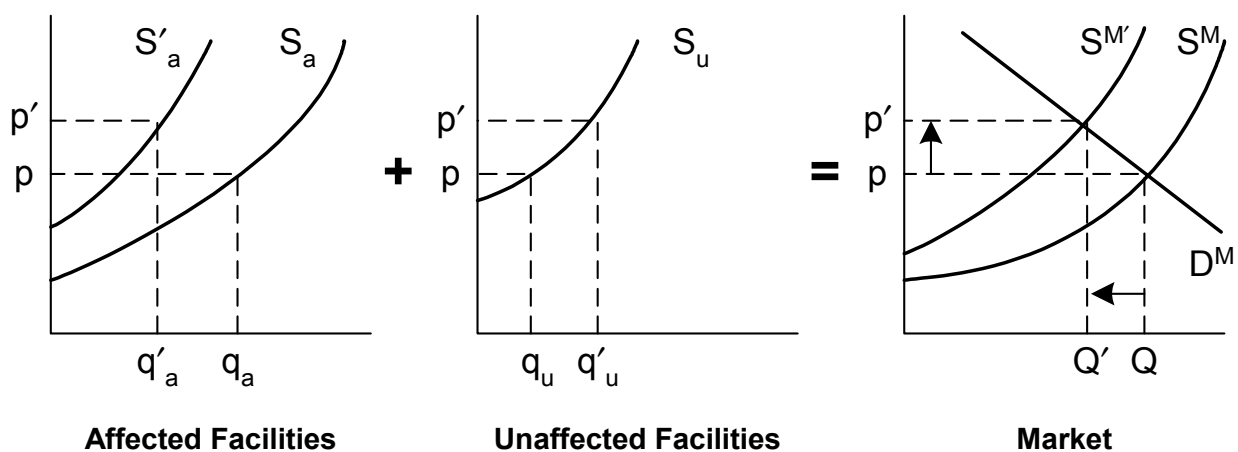
A graphical representation of the competitive model of price formation, as shown in Figure 4-1(a), posits that market prices and quantities are determined by the intersection of the market supply and demand curves. Under the baseline scenario, a market price and quantity (p, Q) are determined by the downward-sloping market demand curve (D^M) and the upward-sloping market supply curve (S^M) that reflects the sum of the domestic supply curves. EPA's model includes both affected and unaffected domestic supply.

With the regulation, the costs of production increase for affected domestic suppliers. The imposition of these regulatory control costs is represented as an upward shift in the affected facility supply curve. As a result of the upward shift in this supply curve, the market supply curve for metal cans will also shift upward as shown in Figure 4-1(b) to reflect the increased costs of production.

⁷However, empirical studies in the literature have generally found little evidence of environmental regulations having a significant influence on industry location decisions (e.g., Levinson, 1996).



a) Baseline Equilibrium



b) With-Regulation Equilibrium

Figure 4-1. Market Equilibrium without and with Regulation

In baseline without the proposed standards, the industry produces total output, Q , at price, p , with domestic producers supplying the amount q_a and imports accounting for Q minus q_a , or q_u . With the regulation, the market price increases from p to p_N and market output (as determined from the market demand curve, D^M) declines from Q to Q_N . This reduction in market output is the net result of reductions in affected domestic supply and increases in unaffected supply.

4.2.5 Impacts for Facilities Excluded from the Market Model

After review of the available data, the Agency determined that 13 facilities manufactured unique metal can commodities that did not fall within the market definitions above (e.g., commemorative tins). However, the Agency concluded data limitations did not support the development of similar partial equilibrium models for these commodities. As a result, the Agency employed a simple nonbehavioral financial analysis to estimate impacts, which takes the form of the ratio of compliance costs to the value of sales (cost-to-sales ratio or CSR). To compute these ratios, EPA collected revenue data and calculated a CSR for each of the firms as follows:

$$\text{CSR} = \text{Total Annualized Compliance Costs} / \text{Total Plant Revenue} \quad (4.1)$$

One drawback of this approach is that it does not consider interactions between producers and consumers in a market context. The analysis simply assesses the burden of the rule by assuming the affected firms fully absorb the control costs, rather than at least partially passing them on to consumers in the form of higher prices. Therefore, it likely overstates the impacts on facilities affected by the rule and understates the impacts on consumers. However, the approach can provide a quantitative measure of the economic impacts for these facilities and has the advantages of simplicity and relatively limited data requirements.

4.3 Economic Impact Results

To develop quantitative estimates of these impacts, we developed a computer model using the conceptual approach described above.⁸ Using this model, EPA characterized supply and demand of three affected commodities for the baseline year, 1997; introduced a policy “shock” into the model by using control cost-induced shifts in the domestic supply functions of these markets; and used the market model to determine a new with-regulation equilibrium in each metal cans market. We report the market, industry, and societal impacts projected by the model below.

4.3.1 Market-Level Impacts

The increased cost of production due to the regulation is expected to increase the price of metal cans and reduce production/consumption from baseline levels. As shown in Table 4-1, the price increases in all three metal can markets are similar in magnitude and are each less than 0.5 percent. Domestic production of metal cans is estimated to decline by a total of 392 million cans, or 0.30 percent. The beverage can market accounts for 80 percent of this decline, which is approximately proportionate to its share of metal cans produced.

⁸Appendix A includes a description of the model’s baseline data set and specification.

Table 4-1. Market-Level Impacts of the Metal Can MACT: 1997

Market	Baseline	With Regulation	Absolute Change	Relative Change
Price (\$/can)	\$0.061	\$0.061	\$0.000	0.23%
Revenues (\$10 ⁶ /yr)	\$10,848.12	\$10,849.63	-\$1.51	0.01%
Costs (\$10 ⁶ /yr)	\$10,030.25	\$10,047.40	\$17.16	0.17%
Compliance	\$0.00	\$48.50	\$48.50	NA
Production	\$10,030.25	\$9,998.90	-\$31.34	-0.31%
Pre-tax earnings (\$10 ⁶ /yr)	\$817.87	\$802.22	-\$15.65	-1.91%
Plants (#)	156	156	0	0.00%
Employees (#)	20,846	20,670	- 176	-0.84%
Total^a				
Price (\$/can)	\$0.084	\$0.084	\$0.000	0.31%
Quantity (10 ⁶)	129.387	128.995	-392	-0.30%

^a The prices reported for the total impacts on the metal can manufacturing industry are weighted averages of the prices in the three submarkets above.

4.3.2 Industry-Level Impacts

Revenue, costs, and profitability of the directly affected industry also change as prices and production levels adjust to increased costs associated with compliance. For metal can producers, pre-tax earnings are projected to decrease by a total of about \$16 million across all three submarkets included in the economic model (see Table 4-2).⁹ These losses are the net result of three effects:

- C Increases in revenue (\$1.51 million, or 0.01 percent)—based on the elasticities used in the model, revenue increases slightly because the average price of metal cans increases by a larger percentage than the quantity falls.
- C Reductions in production costs as output declines (\$31.3 million, or 0.31 percent)—production costs fall as firms reduce their output.¹⁰
- C Increased control costs (\$48.5 million)—we have assumed total annualized compliance costs vary with the level of output. Therefore, the compliance costs being incurred with regulation are smaller than the engineering compliance costs presented in Section 3 because the

⁹Note that there are only 156 facilities included in the market model after excluding the facilities that did not fit into the three metal can markets modeled and allocating costs assigned to facilities that only manufacture sheets or ends to their sister facilities that manufacture the cans. This adjustment was made because the facilities producing only sheets or ends do not compete directly in the can market, although changes in the costs of producing these inputs will affect company-level can output.

¹⁰Note that this does not imply that production costs per unit are falling, only that total production costs will tend to fall as less output is produced. For example, fewer raw materials are needed as output declines.

estimated reductions in output imply lower compliance costs.¹¹

The national-level results also highlight important distributional impacts of the rule across facilities, as shown in Table 4-3. Approximately one-third of the modeled facilities experience an increase in pre-tax earnings totaling about \$10.3 million as a result of increases in price that exceed their compliance costs per unit. In contrast, the remaining two-thirds of metal can facilities experience losses in pre-tax earnings totaling \$26.0 million. As expected, facilities who are better off with regulation have relatively lower per-unit compliance costs than their competitors.

The Agency also examined impacts on the 13 facilities not included in the market model. By assumption, these producers experience reductions in profit equal to the total annualized compliance costs estimated to fall on those facilities (\$4.5 million), an average of \$350,000 per facility (see Table 4-
Table 4-3. Distributional Impacts Across Facilities of the Metal Can MACT: 1997

	Pre-Tax Earnings		Total
	Loss	Gain	
Plants (#)	99	57	156
Baseline Production			
Total (units/yr)	86,117,362,896	35,843,620,632	121,960,983,528
Average (units/facility)	887,807,865	607,518,994	781,801,176
Baseline Compliance Costs			
Total (\$10 ⁶ /yr)	\$45,450,401	\$4,167,867	\$49,618,268
Average (\$/unit)	\$0.0005	\$0.0001	\$0.0004
Change in Pre-tax Earnings (\$10 ⁶ /yr)	-\$25.90	\$10.25	-\$15.65
Change in Employment (# employees)	-309	133	-176

4). Revenues for these companies were estimated based on data collected from Dun & Bradstreet, Reference USA, Thomas Regional, and the Census Bureau. Reference USA provides facility-level sales ranges, but this data was not available for all 13 facilities. Therefore, we used Census estimates of

¹¹Compliance costs are expected to be lower, on average, as output falls because many types of compliance costs are typically assumed to vary with output. For example, as output falls, some firms may be able to meet pollution abatement requirements with smaller, less expensive control equipment.

Table 4-4. Impacts for Facilities Not Included in the Market Model: 1997

Total Number of Facilities	13	
Total Annualized Compliance Costs (TACC) (\$10 ⁶)	\$4.5	
Average (TACC) per Facility (\$10 ⁶)	\$0.35	
	Number	Share
Facilities with Sales Data		
Compliance costs are < 1% of sales	9	69%
Compliance costs are ≥ 1% and < 3% of sales	3	23%
Compliance costs are ≥ 3% of sales	1	8%
Compliance Cost-to-Sales Ratios		
Average	1.34%	
Median	0.43%	
Minimum	0.00%	
Maximum	10.20%	

the average revenue per metal can manufacturing establishment for the employment size category that the facility falls into as an estimate of facility-level revenue for those facilities where Reference USA data were not available. Because Reference USA provides fairly wide ranges in its sales estimates, EPA chose to use a conservative estimate of facility revenue by using the minimum of:

- C Total company sales (from Dun & Bradstreet or Thomas Regional),
- C Midpoint of facility-level sales range reported by Reference USA, and
- C Census estimates of the average revenues per establishment for the metal can industry for the state in which the facility is located.

This was done to ensure that we were not using facility-level sales that were greater than total company sales and that the Reference USA estimate was not far out of line with the standard industry output for an establishment with a given employment range. Relative to estimated baseline sales for these facilities, nine facilities are impacted less than one percent, three are impacted between 1 and 3 percent of sales, and one facility is impacted at a level above 3 percent of sales.

4.3.3 Closure Estimates

As shown, the economic model does not predict any facilities included in the market model will close following regulation under the reference case elasticity assumptions. However, sensitivity analysis shows that one facility may close under different supply and demand elasticity assumptions. In addition, the cost-to-sales analysis for the 13 facilities not included in the economic model shows that one facility has a CSR exceeding 10 percent. The U.S. Bureau of Census reports industry group financial ratios in their *Quarterly Financial Report for Manufacturing, Mining and Trade Corporations* (U.S. Bureau of the Census, 1998). For 1997, the Census Bureau reports that income before income taxes (pre-tax earnings) for SIC group 34 (Fabricated Metal Products) was approximately 7.6 percent of sales. For smaller firms (i.e., firms with assets under \$25 million) this ratio is 6.9 percent¹². Therefore,

¹²In the short run, a plant would be presumed to continue to operate as long as variable profits are positive. The Agency considered QFR's income before income taxes measure as a reasonable approximation of plant-level variable

the Agency believes the rule may potentially result in one to two premature plant closures.

4.3.4 *Employment Impacts*

Reduction in domestic production leads to changes in industry employment. Facility-level changes in employment were estimated by multiplying the change in production by baseline employment:

$$\Delta E_i = \left[\frac{\Delta Q}{Q} \right] E_0 \quad (4.2)$$

Employment is projected to decline by 309 employees at plants with profit losses and increase by 133 employees at facilities with profit gains. EPA estimates the net employment change resulting from the rule is a reduction of 176 employees, or –0.8 percent.

4.3.5 *Social Costs*

The value of a regulatory action is traditionally measured by the change in economic welfare that it generates. The regulation's welfare impacts, or the social costs required to achieve environmental improvements, will extend to consumers and producers alike. Consumers experience welfare impacts due to changes in market prices and consumption levels associated with the rule. Producers experience welfare impacts resulting from changes in profits corresponding with the changes in production levels and market prices. However, it is important to emphasize that this measure does not include benefits that occur outside the market, that is, the value of reduced levels of air pollution with the regulation.

The economic analysis accounts for behavioral responses by producers and consumers to the regulation (i.e., shifting costs to other economic agents). This approach provides insights on how the regulatory burden is distributed across stakeholders. As shown in Table 4-5, the economic model estimates the total social cost of the rule at \$53.5 million. As a result of higher prices and lower consumption levels, consumers (domestic and foreign) are projected to lose \$33.3 million, or 60 percent

Table 4-5. Distribution of Social Costs for the Metal Can MACT: 1997

	Value (\$10 ⁶ /yr)
Change in Consumer Surplus	–\$33.3
Beverage	–\$13.9
Food	–\$10.8
Packaging	–\$8.5
Change in Producer Surplus	–\$20.2
Market model	–\$15.6
Not modeled	–\$4.5
Total Social Cost	–\$53.5

of the total social costs of the rule. Beverage market consumers experience over one-third of these losses, or \$13.9 million. Producer surplus declines by \$20.2 million, or 40 percent of the total social costs.

4.3.6 *Sensitivity Analysis*

As a result of uncertainty involved in selecting point estimates of supply and demand elasticities, EPA also conducted sensitivity analysis to explore the effect of different elasticity values. Detailed results of this sensitivity analysis are presented in Appendix B. The social costs of the rule remain essentially unchanged in the sensitivity analysis. As expected, changes in elasticities that make the

profit rate.

consumer more responsive to marginal changes in price relative to producers results in lower consumer surplus losses and higher producer surplus losses. Conversely, changes in elasticities that make the producer more responsive to marginal changes in price relative to consumers results in higher consumer surplus losses and lower producer surplus losses. Finally, closure estimates ranged from 0 to 1 facility under all scenarios for those facilities included in the market model.

4.4 New Source Analysis

Potential new suppliers of metal cans have an investment decision concerning whether or not to enter the market (or to build new facilities in the case of current market participants). Economic theory tells us that investors are only expected to invest in projects that are expected to have a positive net present value (NPV), that is, an internal rate of return higher than the opportunity cost of capital. Therefore, to the extent that the metal can manufacturing NESHAP will result in a decrease in the expected NPV of investing in new plants, it could potentially reduce the number of new entrants. However, EPA has estimated that there would most likely be no new entrants in the metal can manufacturing industry over the next few years even in the absence of this NESHAP. Thus, EPA concludes that there will be no impacts on new sources as a result of this regulation.

4.5 Energy Impact Analysis

Executive Order 13211, “Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use” (66 Fed. Reg. 28355, May 22, 2001), requires federal agencies to estimate the energy impact of significant regulatory actions. The proposed NESHAP will trigger both a small increase in energy use due to the operation of new abatement equipment as well as a decrease in energy use due to a small decline in the production of metal cans. These impacts are discussed below.

Based on information from the industry survey responses, it is not expected that the substitution of low HAP coatings and thinners for the materials currently used would result in any change in energy usage. However, because many metal can manufacturing facilities use add-on emission control devices to meet existing limits, it is expected that these facilities would use additional add-on controls to comply with the MACT standard. Facilities are expected to add RTOs to reduce HAP emissions, which require electricity and the combustion of natural gas to operate and maintain operating temperatures. EPA estimates that electricity consumption will increase by 36,730,000 kilowatt-hours (kWh) per year and fuel energy consumption resulting from burning natural gas will increase by 1,197,000 million British thermal units (MMBtu) per year, which roughly corresponds to 1.2 billion cubic feet of natural gas. The total electricity generation capacity in the U.S. in 1999 was 785,990 MW (DOE, 1999a). Thus, the electricity requirements associated with the new abatement capital likely to be added to comply with this NESHAP represents a very small fraction of domestic generation capacity. Similarly, the natural gas requirements associated with the NESHAP are very small relative to the 23,755 billion cubic feet of natural gas produced in the U.S. in 1999 (DOE, 1999b).

In addition, as described in Section 4.3, the economic model predicts that increased compliance costs will result in a reduction in annual output of 0.3 percent for the metal can manufacturing industry. This small decline in production is expected to result in an approximately proportionate reduction in energy consumption for this sector and will partially offset the increased consumption to operate add-on control devices.

Overall, both the increases and decreases in energy consumption expected to result from implementation of the metal can manufacturing NESHAP are projected to be extremely small relative to national energy markets (and will at least partially offset each other). Thus, it is extremely unlikely that the proposed NESHAP will have any significant adverse impact on energy prices, distribution, availability, or use.

SECTION 5

SMALL BUSINESS ANALYSIS

This regulatory action will potentially affect the economic welfare of owners of metal can manufacturers. These individuals may be owners/operators who directly conduct the business of the firm or, more commonly, investors or stockholders who employ others to conduct the business of the firm on their behalf through privately held or publicly traded corporations. The legal and financial responsibility for compliance with a regulatory action ultimately rests with plant managers, but the owners must bear the financial consequences of the decisions. Although environmental regulations can affect all businesses, small businesses may have special problems complying with such regulations.

The Regulatory Flexibility Act (RFA) of 1980 requires that special consideration be given to small entities affected by federal regulations. The RFA was amended in 1996 by the Small Business Regulatory Enforcement Fairness Act (SBREFA) to strengthen its analytical and procedural requirements. Under SBREFA, the Agency must perform a regulatory flexibility analysis for rules that will have a significant impact on a substantial number of small entities.

This section focuses on the compliance burden of the small businesses within the metal can manufacturing industry and provides a screening analysis to determine whether this proposed rule is likely to impose a significant impact on a substantial number of the small entities (SISNOSE) within this industry. The screening analysis employed here is a “sales test” that computes the annualized compliance costs as a share of sales for each company. In addition, it provides information about the impacts on small businesses using a market analysis that accounts for behavioral responses to the proposed rule and the resulting changes in market prices and output.

5.1 Identifying Small Businesses

The Small Business Administration (SBA) released guidelines effective October 2000 that provide small business thresholds based on NAICS codes that replace the previous thresholds based on SIC codes. Under these new guidelines, SBA establishes 1000 or fewer employees as the small business threshold for Metal Can Manufacturing (i.e., NAICS 332431). Using this guideline and available secondary data, the Agency identified 13 small businesses, or 43.3 percent of the metal can companies. For these small businesses, the average (median) annual sales for companies reporting data were \$27 (\$24) million, and the average (median) employment was 178 (175) employees.

5.2 Screening-Level Analysis

To assess the potential impact of this rule on small businesses, the Agency calculated the share of annualized compliance costs relative to baseline sales for each company. This type of analysis does not consider interaction between producers and consumers in a market context. Therefore, it likely overstates the impacts producer impacts and understates the impacts on consumers. When a company owns more than one affected facility, EPA combined the costs for each facility owned by that company to generate the numerator of the cost-to-sales ratio. Annualized compliance costs include total annualized capital costs and operating and maintenance costs imposed on these companies.

5.2.1 Results

Small businesses are expected to incur only 2 percent of the total industry compliance costs of \$56.2 million (see Table 5-1).¹³ The average total annualized compliance cost is projected to be \$90,000 per small company. The mean (median) cost-to-sales ratio for the 13 small businesses is 1.10 (<0.001)

¹³This disproportionately small impact is primarily due to the fact that relatively few small businesses in the metal can manufacturing industry are major sources.

percent, with a range of 0 to 10.20 percent. EPA estimates that 10 of the 13 small businesses experience an impact less than 1 percent of total company sales, two small firms have CSRs between one and 3 percent, and one firm has a CSR greater than 3 percent of sales.

Large businesses are expected to incur 98 percent of the total industry compliance costs of \$56.2 million. The average total annualized compliance cost is projected to be \$3.2 million per large company. The mean (median) cost-to-sales ratio for the 17 large businesses is 0.27 (0.14) percent, with a range of 0 to 1.29 percent. EPA estimates that 16 of the 17 large businesses experience an impact less than 1 percent of total company sales and one large firm has a CSR between 1 and 3 percent.

Table 5-1. Summary Statistics for SBREFA Screening Analysis: 1997

	Small		Large		Total	
Total Number of Companies	13		17		30	
Total Annualized Compliance Costs (TACC) (\$10 ⁶)	\$1.1		\$55.1		\$56.2	
Average (TACC) per Company (\$10 ⁶)	\$0.09		\$3.24		\$1.87	
	Numbe r	Share	Numbe r	Shar e	Numbe r	Shar e
Companies with Sales Data	13	100%	17	100%	30	100%
Compliance costs are < 1% of sales	10	77%	16	94%	26	87%
Compliance costs are ≥1% and < 3% of sales	2	15%	1	6%	3	10%
Compliance costs are ≥ 3% of sales	1	8%	0	0%	1	3%
Compliance Cost-to-Sales Ratios						
Average	1.10%		0.27%		0.63%	
Median	0.00%		0.14%		0.06%	
Minimum	0.00%		0.00%		0.00%	
Maximum	10.20%		1.29%		10.20%	

5.3 Economic Analysis

The Agency also analyzed the economic impacts on small businesses who own operate facilities included in the market model under with-regulation conditions expected to result from implementing the NESHAP. Unlike the screening analysis, this approach examines small business impacts in light of the behavioral responses of producers and consumers to the regulation. As shown in Table 5-2, the economic model projects pre-tax earnings to marginally increase by approximately \$1.98 million, or 0.46 percent, for the eight small businesses¹⁴ included in the market model. As noted earlier, small firms only bear 2 percent of the total annualized control costs and the per-unit costs of control are smaller relative to other affected firms, leading to an estimated increase in the level of pre-tax earnings. This increase is the net result of three effects:

¹⁴The eight small businesses included in the market model own a total of nine plants.

Table 5-2. Small Business Impacts of the Metal Can MACT After Market Adjustments: 1997^a

	Baseline	With Regulation	Absolute Change	Relative Change
Revenues (\$10 ⁶ /yr)	\$560.87	\$560.54	-\$0.33	-0.06%
Costs (\$10 ⁶ /yr)	\$132.06	\$129.75	-\$2.31	-1.75%
Compliance	\$0	\$0.05	\$0.05	NA
Production	\$132.06	\$129.70	-\$2.37	-1.79%
Pre-tax Earnings (\$10 ⁶ /yr)	\$428.80	\$430.78	\$1.98	0.46%
Plants	9	9	0	0.00%
Employment	1,205	1,181	-24	-1.98%

^a This table only presents results for those small firms included in the market model. There are an additional six plants owned by five small firms that manufacture speciality products and were therefore not included in the market model.

- C Decrease in revenue (\$0.33 million, or -0.06 percent)—revenue declines as output declines. This is offset to some degree by increases in the market price of metal cans (i.e., each metal can is sold at a higher market price).
- C Decrease in production costs (\$2.37 million, or 1.8 percent)—production costs decline as output falls.
- C Increased pollution control costs (\$0.05 million)—these costs increase with the rule, although the estimated costs after allowing for behavioral adjustments are smaller than those estimated by the engineering cost analysis because these costs are assumed to vary with output. Given that output declines, pollution control costs also decline relative to the costs estimated by the engineering analysis.

5.4 Assessment

After considering the economic impacts of the proposed rule on small entities, EPA certifies that there will not be significant impacts on a substantial number of small entities. We provide the following factual basis for certification:

- C The screening analysis shows only one of the 13 small firms is impacted greater than 3 percent of total revenues.
- C Only one of the 15 facilities owned by small businesses is likely to prematurely close as a result of the rule using the base elasticity assumptions. A second facility is estimated to close under some of the scenarios included in the sensitivity analysis.
- C After taking into account behavioral responses of producers and consumers to the regulation, plants owned by small businesses included in the market model (nine total) experience a net increase in pre-tax earnings of \$1.98 million.
- C EPA does not anticipate that small firms will be disproportionately affected relative to large firms. Small firms are only expected to incur approximately 2 percent of the total annualized costs of \$56.2 million. In addition, the average total annualized compliance costs are \$90,000 per small firm compared to \$3.2 million for large firms. Finally, a comparison of the cost-to-sales estimates shows small firms have a lower median CSR relative to large firms (<0.01 percent compared to 0.14 percent for the large firms, and 0.06 percent across all affected firms).

Although this proposed rule will not have a significant economic impact on a substantial number of small entities, EPA continues to be interested in the potential impacts of the proposed rule on small entities and welcome comments on issues related to such impacts.

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Table A-1. Baseline Data Set, 1997

Market	Average Price (\$/can)	Domestic Production (10 ⁶ cans)
Beverage	\$0.06	100,680
Food	\$0.12	24,332
Package	\$0.44	4,375

Sources: Sfiligoj, Eric. June 1995. "At What Price?" *Beverage World* June:46-50.
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APPENDIX A MODEL DATA SET AND SPECIFICATION

The primary purpose of the EIA for the proposed metal can manufacturing MACT is to describe and quantify the economic impacts associated with the rule. The Agency used a basic framework that is consistent with economic analyses performed for other rules to develop estimates of these impacts. This approach employs standard microeconomic concepts to model behavioral responses expected to occur with regulation. This appendix describes the spreadsheet model in detail and discusses how the Agency

- C collected the baseline data set for the model,
- C characterized market supply and demand for three submarkets of the metal can industry—beverage cans, food cans, and general packaging containers.
- C introduced a policy “shock” into the model by using control cost-induced shifts in the facility-level supply functions, and
- C used a solution algorithm to determine a new with-regulation equilibrium for each market.

A.1 Baseline Data Set

EPA collected the following data to characterize the baseline year, 1997 (see Tables A-1 and A-2):

- C *Baseline Quantity*—EPA collected facility-level production and mapped facilities to appropriate markets using ICR survey responses. We estimated facility-level production for plants without ICR data using the following approach:
 - T Collected secondary data on market-level output for each of the three categories of metal cans modeled from a publicly available source provided by the CMI (see Table 2-7).
 - T Computed the difference between total market output for each of the three

categories modeled and total reported output calculated from summing ICR responses for each market (i.e., total production–total reported ICR production = total unknown production)

Distributed unknown production across facilities that did not provide production data¹⁵ using ICR plant-level employment responses. Using this approach, the facility-level model is consistent with secondary market data.

C *Baseline Prices*—EPA computed 1997 baseline prices for the beverage can market using data from Sfiligoj (1995) and price indexes from BLS (2001a). For the food can and general packaging container markets, the Agency employed the following approach:

T First, we estimated total revenue for the beverage can market using price¹⁶ and total output.

T Next, we collected value of shipment data from the U.S. Census Bureau for Metal Can Manufacturing (NAICS 332431) to obtain an estimate of total industry revenue. We then subtracted revenue from the beverage market (as calculated above) from total revenue to approximate the total revenue in the food can *and* general packaging container markets.

Table A-2. Primary Supply and Demand Elasticities for Metal Can Market Models

Market	Supply	Demand
Beverage	1	–1.4
Food	1	–0.63
Package	1	–0.63

Sources: Palmer, K., H. Sigman, and M. Walls. 1996. “The Cost of Reducing Municipal Solid Waste.” Resources for the Future Discussion Paper 96-35.

T Using census data, CMI, and ICR data, we estimated the average revenue per employee for the food can *and* general packaging container markets. We multiplied this value by total plant-level employment for each market to derive an estimate of total revenue for each market.

T Finally, we divided these two revenue estimates by their respective market quantities to compute a market price. Using this approach, the facility-level revenue totals are consistent with the value of shipments for the industry reported by the Census Bureau (i.e., does not significantly understate or overstate total industry revenues).

C Domestic supply and demand elasticities—The primary demand elasticities used for this analysis are drawn from Palmer, Sigman, and Walls (1996). They report demand elasticities of –1.4 for aluminum beverage cans and –0.63 for steel cans. Because no empirical estimates of the supply elasticity were identified, the primary supply elasticity was assumed to be equal to 1. Because of the inherent uncertainty

¹⁵These are primarily area sources. In general less information was collected from area sources than major sources because major sources are the focus of the rule. However, it is important to capture production from all sources to accurately develop the baseline and estimate post-regulation market conditions.

¹⁶EPA used the price of aluminum cans (\$0.061/can) for the beverage market because the overwhelming majority of beverage cans are made from aluminum.

associated with choosing point estimates of elasticities, a sensitivity analysis was conducted where the supply elasticity was varied from 0.5 to 2 and the demand elasticity was varied from -0.5 to -2 .

A.2 Supply of Metal Cans

The market supply of metal cans in each of the three defined submarkets (Q^s) may be expressed as the sum of affected and unaffected producers, that is,

$$Q^s = q_a + q_u \quad (A.1)$$

where q_a is the affected supply of a particular can type and q_u is the unaffected supply.

A.2.1 Metal Can Facilities

Producers of metal cans have some ability to vary output in the face of production cost changes. Production cost curves, coupled with data on market prices, can be used to determine the facility's optimal production rate, including zero output (shut-down). EPA used the a Generalized Leontief profit function to characterize metal can facility supply curves.

A.2.1.1 Using the Generalized Leontief Profit Function to Derive Output Supply

The specification of a facility's profit function given by the generalized Leontief is as follows:¹⁷

$$\pi_j = \frac{P_n}{\sum_{n=1}^3 \left(\frac{I_{jn}^{\alpha_n}}{\beta_n} \right)} \quad (A.2)$$

Eq. (A.2) is an empirical model to estimate facilities' profit, where P_n is the net market price for product n manufactured by facility j , I_{jn} is one variable proportion input (characterized by a cost index described below), β_0 , β_1 , and β_2 are model parameters, j indexes producers (i.e., affected facilities), and n represents the three commodities included in the market model. By applying Hotelling's lemma to the generalized Leontief profit function, the following general form of the product n supply function for facility j is obtained:

$$q_{jn} = \frac{\partial \pi_j}{\partial P_n} = \frac{P_n}{\sum_{n=1}^3 \left(\frac{I_{jn}^{\alpha_n}}{\beta_n} \right)} \left[\frac{I_{jn}^{\alpha_n}}{\beta_n} \right] \quad (A.3)$$

where q_{jn} is the quantity of product n produced by facility j , P_n is the net market price for each product, I_{jn} is the variable proportion input, ($\beta_0 = \beta_1 = \beta_2 = \beta_n$ are model parameters, j indexes producers (i.e., affected facilities), and n represents the three markets. The theoretical restrictions on the model parameters that ensure upward-sloping supply curves are ($\beta_n > 0$ and $\alpha_n < 0$).

Figure A-1 illustrates the theoretical supply function for product n represented by Eq. (A.3). As shown, the upward-sloping supply curve is specified over a productive range with a lower bound

of zero that corresponds with a shutdown price equal to $\frac{P_n}{\sum_{n=1}^3 \left(\frac{I_{jn}^{\alpha_n}}{\beta_n} \right)}$ and an upper bound given by the

productive capacity of q_j^M that is approximated by the supply parameter (β_n). The curvature of the

¹⁷For additional details, see Chambers (1988) for a discussion of this functional form (pages 172-173).

supply function is determined by the β_n parameter.

Supply function parameters: The β parameter is related to the facility j 's supply elasticity for product n , which can be expressed as

$$\beta_n = \frac{\partial q_j}{\partial p} \cdot \frac{p}{q_j} \quad (A.4)$$

Taking the derivative of the facility supply function (Eq. [A.3]) with respect to price shows

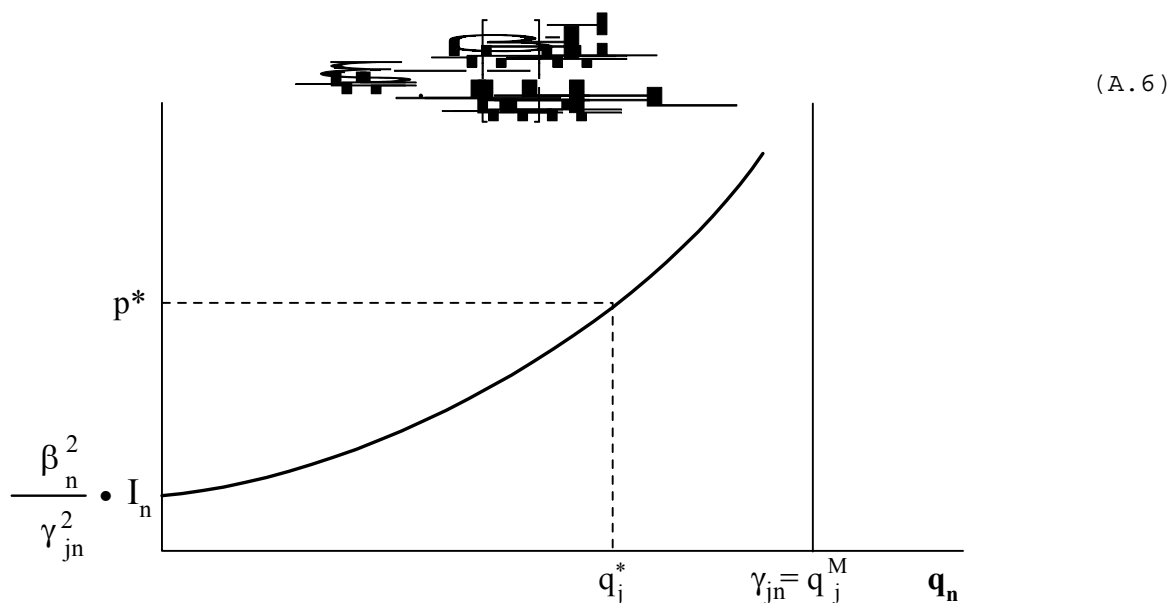
Multiplying this expression by P_n/q_n results in the expression for the supply elasticity:

$$\beta_n = \frac{\partial q_j}{\partial p} \cdot \frac{p}{q_j} \quad (A.5)$$

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n be expressed as follows:



$$\beta_n = \frac{\partial q_j}{\partial p} \cdot \frac{p}{q_j} \quad (A.7)$$

Values for the β parameter can be computed in two ways: econometric estimation using facility survey data¹⁸ or substitution of an econometrically estimated or assumed market supply elasticity for product n (β_n), the average annual production level of facilities (q_{jn}), the variable production cost index (I_{jn}), and the market price of the product n (P_n). Note that unlike the product-specific β , the facility supply elasticity is not constant but varies with q , p , and I . For this analysis, we used the calibration approach because facility-level data available from the Information Collection Request (ICR) did not support econometric estimation. Using this approach, the remaining supply function parameter, γ_{jn} , approximates the productive capacity and varies across products

¹⁸For a discussion, see EPA (1993) and Thurman, Fox, and Bingham (2001).

at each facility. This parameter does not influence the facility's production responsiveness to price changes as does the β parameter. Thus, the parameter β_{jn} is used to calibrate the model so that each facility's supply equation replicates the baseline production data.

Variable production cost index: The cost-share weighted variable production cost index, I_j , was constructed with the following data from the U.S. Bureau of Census:

- C state-level wages paid by the metal can industry (NAICS 332431) divided by value of shipments (w) and
- C state-level materials purchased by the metal can industry (NAICS 332431) divided by the value of shipments (m).

Note, the I_j variable *varies across facilities* due to the two state-level variables (w , m).

Before computing the cost-share weighted index, the wage and materials variables were converted into indexes normalized to the average value of each variable. This conversion allows each variable to be measured in terms of a relative index. The state specific index was computed as follows:

$$I_j = \frac{w_j}{\bar{w}} + \frac{m_j}{\bar{m}} \quad (A.8)$$

where \bar{w} is the national cost share of materials for the metal can industry (NAICS 332431) and $1 - \bar{w}$ is the national cost share of wages. Table A-3 summarizes the normalized cost index values computed for states with available data.

Regulatory Response: The production decisions at these facilities are affected by the total annual compliance costs, c_j , as provided by EPA's engineering analysis of capital costs, annual operating and maintenance costs, record keeping and reporting costs, and applicable monitoring costs required to comply with the metal can MACT. The supply equation of

Table A-3. Variable Cost Indexes, 1997

State	Labor Index ^a	Materials Index ^b	Variable Cost Index ^c
AL	1.01	0.71	0.74
CA	1.02	1.03	1.03
CO	0.89	0.99	0.98
FL	1.00	1.14	1.12
GA	0.94	0.97	0.97
IL	1.35	0.96	1.00
IN	0.63	0.95	0.92
MO	1.08	1.03	1.03
NJ	1.42	0.82	0.88
NY	0.94	1.06	1.05
NC	0.97	1.10	1.08
OH	1.15	0.97	0.99
OK	0.93	1.20	1.18
PA	0.93	1.03	1.02
TN	0.82	1.07	1.05
TX	0.88	0.98	0.97
WA	1.10	0.95	0.97
WI	0.94	1.04	1.03

^a Computed as follows: (State wages/State value of shipments)/(U.S. wages/U.S. value of shipments).

^b Computed as follows: (State cost of materials/State value of shipments)/(U.S. cost of materials/U.S. value of shipments).

^c Computed as follows: 0.90*Materials Index + 0.10*Labor Index; shares were computed as follows: materials share = 0.90 = U.S. cost of materials/sum(U.S. cost of materials+ U.S. wages) and labor share = 1-0.90.

Source: U.S. Bureau of the Census. 1999. *1997 Census of Manufacturing Industries: Metal Can Manufacturing. Core Business Statistics Series*. EC97X-CS3. Washington, DC: Government Printing Office.

each facility will be directly affected by the regulatory control costs, which enter as a net price change (i.e., $p_j - c_j$). Thus, the supply function presented in Eq. (A.3) becomes:

$$q_{jn}^s = \gamma_{jn} + \beta_n \left[\frac{I_{jn}}{p_n - c_j} \right]^{\frac{1}{2}} \quad (A.9)$$

The total annual compliance costs per can, c_j , are estimated given the annual production per facility and the regulatory cost estimates for each facility provided by the engineering analysis. Under this approach, we assume all regulatory costs vary to some degree with output.

Closure Decisions: One of the most sensitive issues to consider in the EIA is the possibility that the regulation may induce a producer to shut down operations rather than comply with the regulation. The data (i.e., direct observations of plant-level costs and profits) necessary to make definitive projections of these impacts are unavailable from the survey data. Therefore, the Agency developed a method of identifying firm closure decisions using industry measures of profitability. The plant closure criterion used for this analysis is:



where

C TR= Total Revenue

C TVPC = Total Variable Production Costs (area under the supply function)

C TFPC = [(1-profit rate)*TR] – TVPC. This accounts for production costs that do not vary with output (i.e., “fixed”) and can be avoided by ceasing production.

C TACC = Total Annual Compliance Costs.

Note that all of these variables are with-regulation values (i.e., they account for market adjustments).

The U.S. Bureau of Census reports industry group financial ratios in their *Quarterly Financial Report for Manufacturing, Mining and Trade Corporations* (U.S. Bureau of the Census, 1998). For 1997, the Census Bureau reports that income before income taxes (pre-tax earnings) for SIC group 34 (Fabricated Metal Products) was approximately 7.6 percent.¹⁹ For smaller firms (i.e., firms with assets under \$25 million) this ratio is 6.9 percent. Given the estimated 1997 values of revenue and variable production costs, EPA developed an estimate of the total fixed production costs so that the pre-tax profit rate for each facility exactly matches the rate reported by the Census.

A.3 Demand for Metal Cans

Domestic demand for metal cans may be expressed by the following general formula for each product:

$$q^d = B^d p^{nd} \quad (\text{A.11})$$

where p is the market price for the product, O^d is the domestic demand elasticity, and B^d is a multiplicative demand parameter that calibrates the demand equation for each product, given data on price and the domestic demand elasticity to replicate the observed 1997 level of domestic consumption.

A.4 With Regulation Market Equilibrium Solution

Producer responses and market adjustments can be conceptualized as an interactive feedback process. Plants facing increased production costs due to compliance are willing to supply smaller quantities at the baseline price. This reduction in market supply leads to an increase in the market price that all producers and consumers face, which leads to further responses by producers and consumers and thus new market prices, and so on. The new with-regulation equilibrium is the result of a series of iterations in which price is adjusted and producers and consumers respond, until a set of stable market prices arises where total market supply equals market demand (i.e., $Q_s = Q_D$). Market price adjustment takes place based on a price revision rule that adjusts price upward (downward) by a given percentage in response to excess demand (excess supply).

The algorithm for determining with-regulation equilibria can be summarized by nine recursive steps:

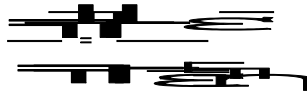
¹⁹In the short run, a plant would be presumed to continue to operate as long as variable profits are positive. The Agency considered QFRs income before income taxes measure as a reasonable approximation of plant-level variable profit rate.

1. Impose compliance costs.
2. Use supply functions to derive marginal responses given the base price.
3. Check if $TR > TC$ (i.e., Eq. [A.7]); if not set $q_i = 0$.
4. Compare aggregate supply and demand.
5. Revise prices using the Walrasian auctioneer approach.
6. Use supply functions to derive marginal responses given the revised price.
7. Check if $TR > TC$ (i.e., Eq. [A.7]); if not set $q_i = 0$.
8. Compare aggregate supply and demand.
9. Go to Step #5 and continue until convergence is obtained (i.e., the difference between supply and demand is arbitrarily small).

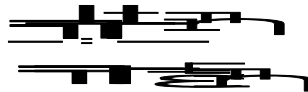
APPENDIX B SENSITIVITY ANALYSIS

As noted in Section 4, EPA's analysis is based on the best point estimates available of the responsiveness of supply and demand for metal cans to changes in their prices. This appendix examines the impact on the estimated results of varying these model parameters. The key results are discussed below:

- C *The social cost estimate remains essentially unchanged under all scenarios*—As shown in Table B-1 and B-2, the social costs vary by 0.1 percent or less in each scenario.
- C *The distribution of costs across producers and consumers depends on the relative supply and demand elasticities*—As consumers become *more (less)* responsive to marginal changes in price relative to producers, they will bear *less (more)* of the regulatory burden. Similarly, as producers become *more (less)* responsive to marginal changes in price relative to consumers, they will bear *less (more)* of the regulatory burden. We can see why these changes occur by examining a very simple mathematical model of tax incidence:²⁰

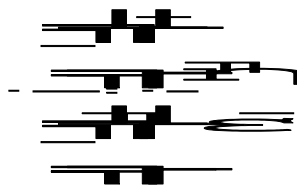


(B.1a)



(B.1b)

²⁰Derivation of this result can be found in intermediate microeconomic textbooks such as Nicholson (1998).



(B.1c)

where

dp^D = price paid by consumers

dp^S = price received by suppliers

dc = per-unit control costs

ϵ^S = market elasticity of supply

η^D = market elasticity of demand

For example, holding market elasticity of supply constant at one and varying the demand elasticity from -0.5 to -2.0 shows consumer losses fall as they become more responsive to price changes declining from $(-\$43.3$ million to $-\$21.6$ million) (see Table B-1).

C *Closure projections slightly increase*—one closure may occur in each market if we reduce the supply elasticity to 0.5 under all demand elasticity scenarios.

Table B-1. Sensitivity Analysis Result Matrix

Supply Elasticity		Demand Elasticity			
		-0.5	-1.0	-1.5	-2.0
0.5	Change in consumer surplus	-\$34.6	-\$23.1	-\$17.3	-\$13.8
	Change in producer surplus	-\$19.1	-\$30.6	-\$36.4	-\$39.8
	Social cost	-\$53.7	-\$53.7	-\$53.7	-\$53.7
	Plant closures	-1	-1	-1	-1
1.0	Change in consumer surplus	-\$43.3	-\$32.5	-\$26.0	-\$21.6
	Change in producer surplus	-\$10.2	-\$21.0	-\$27.5	-\$31.8
	Social cost	-\$53.5	-\$53.5	-\$53.4	-\$53.4
	Plant closures	0	0	0	0
1.5	Change in consumer surplus	-\$47.7	-\$38.1	-\$31.7	-\$27.2
	Change in producer surplus	-\$5.7	-\$15.2	-\$21.5	-\$26.0
	Social cost	-\$53.3	-\$53.3	-\$53.3	-\$53.2
	Plant closures	0	0	0	0
2.0	Change in consumer surplus	-\$50.3	-\$41.8	-\$35.8	-\$31.4
	Change in producer surplus	-\$2.9	-\$11.3	-\$17.3	-\$21.7
	Social cost	-\$53.2	-\$53.2	-\$53.1	-\$53.1
	Plant closures	0	0	0	0